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# EARTH RESOURCES

A CONTINUING BIBLIOGRAPHY WITH INDEXES

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ISSUE 10

AUGUST 1976

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

6

## **PREVIOUS EARTH RESOURCE BIBLIOGRAPHIES**

Remote Sensing of Earth Resources	(NASA SP-7036)
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Earth Resources	(NASA SP-7041(07))
Earth Resources	(NASA SP-7041(08))
Earth Resources	(NASA SP-7041(09))

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# **EARTH RESOURCES**

**A Continuing Bibliography  
With Indexes  
Issue 10**

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced between April 1976 and June 1976 in

- *Scientific and Technical Aerospace Reports (STAR)*
- *International Aerospace Abstracts (IAA)*



*Scientific and Technical Information Office*

**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION**

**AUGUST 1976  
Washington, D.C.**

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# INTRODUCTION

The technical literature described in this continuing bibliography may be helpful to researchers in numerous disciplines such as agriculture and forestry, geography and cartography, geology and mining, oceanography and fishing, environmental control, and many others. Until recently it was impossible for anyone to examine more than a minute fraction of the earth's surface continuously. Now vast areas can be observed synoptically, and changes noted in both the earth's lands and waters, by sensing instrumentation on orbiting spacecraft or on aircraft.

This literature survey lists 506 reports, articles, and other documents announced between April and June 1976 in *Scientific and Technical Aerospace Reports (STAR)*, and *International Aerospace Abstracts (IAA)*.

The coverage includes documents related to the identification and evaluation by means of sensors in spacecraft and aircraft of vegetation, minerals, and other natural resources, and the techniques and potentialities of surveying and keeping up-to-date inventories of such riches. It encompasses studies of such natural phenomena as earthquakes, volcanoes, ocean currents, and magnetic fields; and such cultural phenomena as cities, transportation networks, and irrigation systems. Descriptions of the components and use of remote sensing and geophysical instrumentation, their subsystems, observational procedures, signature and analyses and interpretive techniques for gathering data are also included. All reports generated under NASA's Earth Resources Survey Program for the time period covered in this bibliography will also be included. The bibliography does not contain citations to documents dealing mainly with satellites or satellite equipment used in navigation or communication systems, nor with instrumentation not used aboard aerospace vehicles.

The selected items are grouped in nine categories. These are listed in the Table of Contents with notes regarding the scope of each category. These categories were especially chosen for this publication, and differ from those found in *STAR* and *IAA*.

Each entry consists of a standard bibliographic citation accompanied by an abstract. The citations and abstracts are reproduced exactly as they appeared originally in *STAR*, or *IAA*, including the original accession numbers from the respective announcement journals. This procedure, which saves time and money, accounts for the variation in citation appearance.

Under each of the nine categories, the entries are presented in one of two groups that appear in the following order:

- IAA* entries identified by accession number series A76-10,000 in ascending accession number order.

- STAR* entries identified by accession number series N76-10,000 in ascending accession number order;

After the abstract section, there are five indexes:

- subject, personal author, corporate source, contract number and report/accession number.

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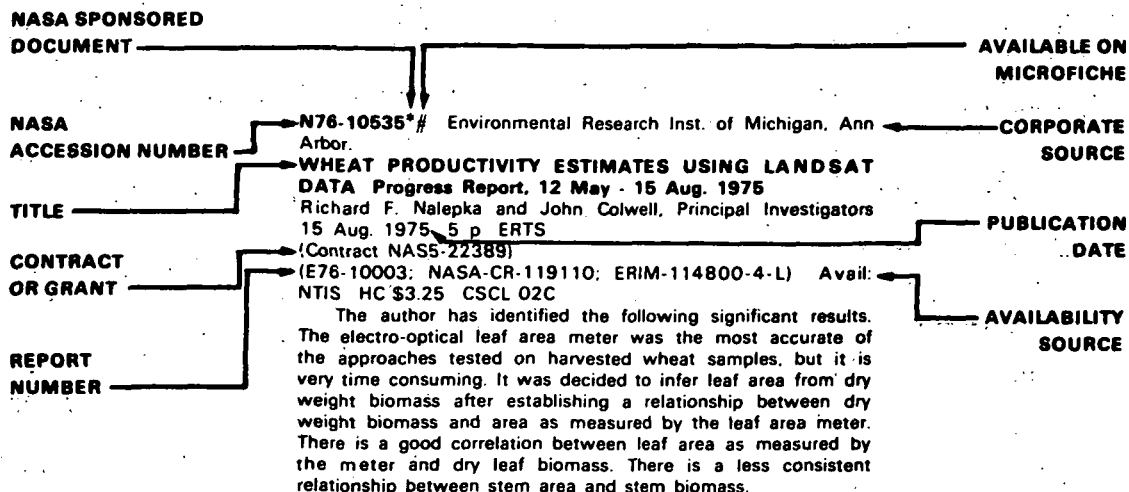
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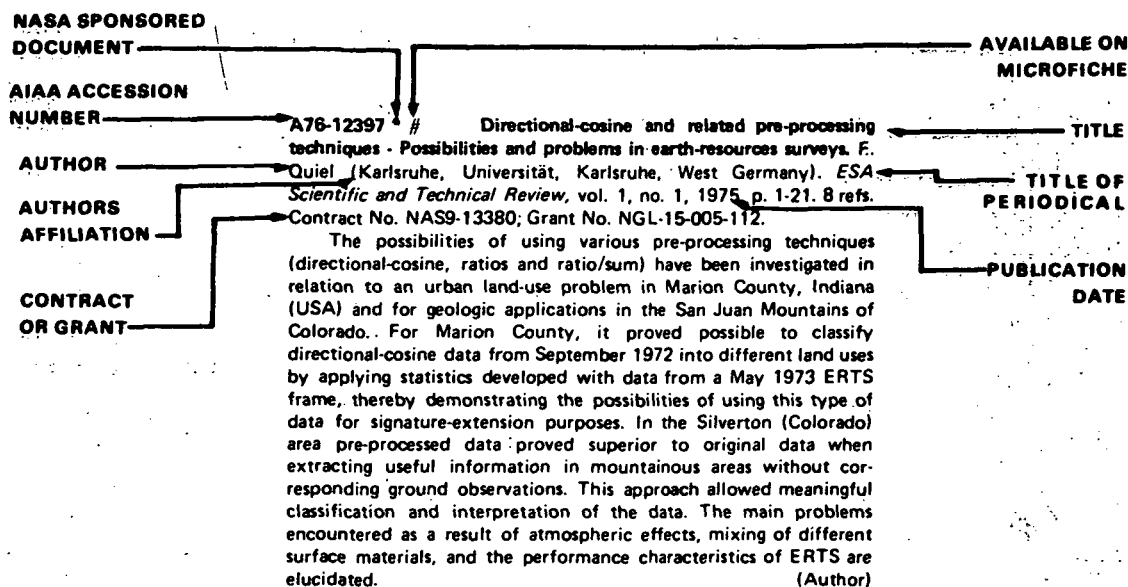
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# EARTH RESOURCES

*A Continuing Bibliography (Issue 10)*

AUGUST 1976

01

## AGRICULTURE AND FORESTRY

Include crop forecasts, crop signature analysis, soil identification, disease detection, harvest estimates, range resources, timber inventory, forest fire detection, and wildlife migration patterns.

**A76-18907 \*** The use of LANDSAT data in a Large Area Crop Inventory Experiment /LACIE/. R. B. MacDonald, F. G. Hall, and R. B. Erb (NASA, Johnson Space Center, Houston, Tex.). In: Symposium on Machine Processing of Remotely Sensed Data, 2nd, West Lafayette, Ind., June 3-5, 1975, Proceedings.

New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 1B-1 to 1B-23, 13 refs.

A Large Area Crop Inventory Experiment (LACIE) has been undertaken jointly by the U.S. Department of Agriculture, the National Oceanic and Atmospheric Administration (NOAA) of the Department of Commerce and the National Aeronautics and Space Administration (NASA) to prove out an economically important application of remote sensing from space. At the outset LACIE will concentrate on wheat grown in the North American area. The experiment will combine crop area measurements obtained from LANDSAT data and meteorological information from NOAA satellites and from ground stations designed to relate weather conditions to yield assessment and ultimately to production forecasts. The Department of Agriculture will study the utilization of the experimentally derived production estimates in its crop reports. These reports are made public as a routine service to the domestic and international agriculture community. If this activity is successful and the results prove useful the application will be extended to other regions and ultimately to other crops. (Author)

**A76-18908 \*** Data resolution versus forestry classification and modeling. E. P. Kan, D. L. Ball, J. P. Basu (Lockheed Electronics Co., Inc., Houston, Tex.), and R. L. Smelser (U.S. Department of Agriculture, Forest Service, Lufkin, Tex.). In: Symposium on Machine Processing of Remotely Sensed Data, 2nd, West Lafayette, Ind., June 3-5, 1975, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 1B-24 to 1B-36, 10 refs. Contract No. NAS9-12200.

This paper examines the effects on timber stand computer classification accuracies caused by changes in the resolution of remotely sensed multispectral data. This investigation is valuable, especially for determining optimal sensor and platform designs. Theoretical justification and experimental verification support the finding that classification accuracies for low resolution data could be better than the accuracies for data with higher resolution. The increase in accuracy is constructed as due to the reduction of scene inhomogeneity at lower resolution. The computer classification scheme was a maximum likelihood classifier. (Author)

**A76-18909** Agricultural analysis of Landsat digital data from Williams County, North Dakota, using G. E. IMAGE 100 system. D. D. Egbert, D. L. Dietrich, and R. E. Fries (General Electric Co., Space Systems Organization, Beltsville, Md.). In: Symposium on Machine Processing of Remotely Sensed Data, 2nd, West Lafayette, Ind., June 3-5, 1975, Proceedings.

New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 1B-45 to 1B-53.

The G. E. IMAGE is a computer system for the processing of multispectral images whose basic feature is the efficient operation of the man-machine interface. It was used to perform an agricultural analysis of Landsat-1 digital data from Williams County, and demonstrated crop acreage measurement accuracies of higher than 90%. The processing techniques involved the use of 64 Landsat gray level resolution single parallelepiped-limit trimming, and the use of only MSS bands 5 and 7. As a further check this processing procedure was also applied to quantify a 3 x 13 km study area near Melfort, Saskatchewan. B.J.

**A76-18912 \*** Acreage estimation, feature selection, and signature extension dependent upon the maximum likelihood decision rule. J. A. Quirein (Lockheed Electronics Co., Inc., Aerospace Systems Div., Houston, Tex.) and M. C. Trichel (NASA, Johnson Space Center, Earth Observations Div., Houston, Tex.). In: Symposium on Machine Processing of Remotely Sensed Data, 2nd, West Lafayette, Ind., June 3-5, 1975, Proceedings.

New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 2A-26 to 2A-39, 9 refs.

A maximum likelihood estimation technique is used for the analysis of agricultural remote sensor data. The m-class probability of misclassification is estimated using unlabeled test samples and labeled training samples. A bound on the variance of a proposed unbiased estimator of the m-class probability of error is derived. The particular case in which each class density is assumed to be a mixture of multivariate normal densities is considered. The extension of spectral signatures in space and time is discussed. B.J.

**A76-18915** Fisheries utilization of remotely sensed data. T. M. Vanselow, T. D. Leming, A. J. Kemmerer, and K. J. Savastano (NOAA, Fisheries Engineering Laboratory, Bay Saint Louis, Miss.). In: Symposium on Machine Processing of Remotely Sensed Data, 2nd, West Lafayette, Ind., June 3-5, 1975, Proceedings.

New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 2B-16 to 2B-22.

The Fisheries Engineering Laboratory has conducted experiments in conjunction with ERTS-1 and Skylab-3 overflights, and is initiating an experiment using LANDSAT data acquisition systems. Data analyses have demonstrated relationships between remotely sensed oceanographic conditions and the distribution and abundance of specific living marine resources. These correlations have been used as the basis for predictive models which, when validated and refined, may benefit the fishing industry and the biological community. (Author)

**A76-19225 \*** Remote sensing of chlorophyll in an atmosphere-ocean environment - A theoretical study. G. W. Kattawar

and T. J. Humphreys (Texas A & M University, College Station, Tex.). *Applied Optics*, vol. 15, Jan. 1976, p. 273-282. 15 refs. Grant No. NGR-44-001-125.

A Monte Carlo program was written to compute the effect of chlorophyll on the ratio of upwelling to downwelling radiance and irradiance as a function of wavelength, height above the ocean, and depth within the ocean. This program simulates the actual physical situation, since a real atmospheric model was used, i.e., one that contained both aerosol and Rayleigh scattering as well as ozone absorption. The complete interaction of the radiation field with the ocean was also taken into account. The chlorophyll was assumed to be uniformly mixed in the ocean and was also assumed to act only as an absorbing agent. For the ocean model both scattering and absorption by hydrosols was included. Results have been obtained for both a very clear ocean and a medium turbid ocean. Recommendations are made for optimum techniques for remotely sensing chlorophyll both in situ and in vitro. (Author)

**A76-20999** Radar look direction and row crops. P. P. Battilvala and F. T. Ulaby (University of Kansas Center for Research, Inc., Lawrence, Kan.). *Photogrammetric Engineering and Remote Sensing*, vol. 42, Feb. 1976, p. 233-238. 13 refs.

Among the parameters affecting the signal strength of the radar return from row crops is the look direction relative to the crop-row direction. Using a mobile truck-mounted 2-8 GHz active microwave spectrometer, radar-backscatter measurements were acquired from a field of sorghum with look directions parallel and orthogonal to the row direction at six incidence angles for both horizontal transmit-horizontal receive (HH) and vertical transmit-vertical receive (VV) polarizations over the band from 2 to 8 GHz. The results confirm observations made from radar imagery indicating that the difference in return between the two look directions increases with wavelength and is larger for HH polarization than for VV polarization. (Author)

**A76-22271 #** Measurement of certain electrophysical properties by radar sounding of frozen soils (Ob-izmerenii nekotorykh elektrofizicheskikh kharakteristik pri zadiolokatsionnom zondirovanii merzlykh pochv). V. G. Glushnev, B. D. Slutsker, and M. I. Finkel'shtein (Rizhskii Institut Inzhenerov Grazhdanskoi Aviatsii, Riga, Latvian SSR). *Radiofizika*, vol. 19, no. 1, 1976, p. 59-63. 10 refs. In Russian.

Results are presented for an experiment in which frozen river-bank soils and swamps were sounded with nanosecond radar pulses at a frequency of 440 MHz from a helicopter. It is shown that oscillograms of the reflected radar signals can be used to determine the depth and constituent materials of frozen ground. These results demonstrate the practical feasibility of remote measurement of the properties of frozen ground with active radar techniques. F.G.M.

**A76-25434** Spectral mapping of shortgrass prairie biomass. R. L. Pearson, L. D. Miller (Colorado State University, Fort Collins, Colo.), and C. J. Tucker. *Photogrammetric Engineering and Remote Sensing*, vol. 42, Mar. 1976, p. 317-321, 323. 5 refs. NSF Grants No. GB-7824; No. GB-13096; No. GB-31862X2; No. GB-41233X.

Multispectral scanner data have been processed to yield biomass maps of imagery from shortgrass prairie vegetation. The results of the image processing of these data were compared to actual biomass values. The comparison demonstrated that image processing predicted 1.15 times the actual biomass present with a correlation coefficient of 0.98 for 26 biomass ground-truth areas sampled from a flight line containing a large range of biomass values. A simple, hand-held device has been constructed which utilizes a spectral ratio between two specific wavelengths, 0.68 and 0.80 micron, to accurately estimate grass biomass. Several field experiments have demonstrated correlation coefficients between 0.95 to 0.98 for the hand-held device in estimating undisturbed grass canopy biomass. The hand-held device has been shown to be an accurate and expedient method for estimating grass canopy biomass. (Author)

**A76-25497 \*** Remote sensing of soil moisture by Skylab radiometer and scatterometer sensors. J. R. Eagleman and F. T. Ulaby (Kansas University, Lawrence, Kan.). *Journal of the Astronautical Sciences*, vol. 23, Apr.-June 1975, p. 147-159. 17 refs. Contract No. NAS9-13273.

A Skylab experiment was designed to evaluate the feasibility of monitoring the moisture content of the soil from space. Data from various Skylab sensors were collected across two test sites while direct measurements of soil moisture were being made at the surface depths of soil. Correlations were obtained between the moisture content of the soil and radiometer sensors (S193 and S194) and the scatterometer instrument (S193). The high correlations obtained indicate that microwave sensors may be quite useful for such measurements in the future. (Author)

**A76-26194 #** Determination of the spectral coefficients of different natural objects. M. Gogoshev and D. Mishev (Bulgarian Academy of Sciences, Central Laboratory for Space Research, Bulgaria). *International Astronautical Federation, International Astronautical Congress, 26th, Lisbon, Portugal, Sept. 21-27, 1975, Paper. 5 p.*

The paper describes a method for the absolute calibration of a spectrophotometer operating in the 380-820 nm range. This spectrophotometer is used to make spectral reflectance measurements of various natural formations and is used for crop and soil studies and applied in agriculture and the forest industry. The normalized filters of the spectrophotometer are calibrated by using the image of the full moon as an astronomical standard. B.J.

**A76-26546 #** The TOPOCART B helps determine forest stand heights from aerial photographs. W. Perlwitz and H. Frommhold (Eberswalde Institute of Forest Sciences, Eberswalde, East Germany). *Jena Review*, vol. 21, no. 2, 1976, p. 71-73. 9 refs.

Difficulties concerning the determination of average forest stand heights from aerial photographs are considered, taking into account also a use of conventional stereoplotting machines. A description is given of a method which attempts to overcome these difficulties with the aid of the TOPOCART B Stereoplotter. The method is based on the measurement of profile sections across the stand. Advantages of the TOPOCART B include a use of paper prints, a simple centration of the photos, and a favorable size of the image field. G.R.

**A76-26549 #** The assessment of intensively worked orchards by aerial photointerpretation. G. Wolff (Eberswalde Institute of Forest Sciences, Eberswalde, East Germany). *Jena Review*, vol. 21, no. 2, 1976, p. 82-87.

An investigation was conducted concerning the possible improvement of current orchard assessment methods by a utilization of aerial photography. The advantages of aerial photography are discussed, taking into account the present state of aerial photography as applied in horticulture. A number of experiments were carried out to obtain information regarding the type of photograph and the scale which would be most suitable for specific studies. Attention is given to the evaluation of the assessment parameters, the study of specific types of plantation, and a cost-efficiency analysis. G.R.

**A76-26844** A comparative study of texture measures for terrain classification. J. S. Weszka, C. R. Dyer, and A. Rosenfeld (Maryland, University, College Park, Md.). *IEEE Transactions on Systems, Man, and Cybernetics*, vol. SMC-6, Apr. 1976, p. 269-285. 7 refs. NSF Grant No. ENG-74-22006; Contract No. F44620-72-C-0062.

Three standard approaches to automatic texture classification make use of features based on the Fourier power spectrum, on second-order gray level statistics and on first order statistics of gray level differences, respectively. Feature sets of these types, all designed analogously, were used to classify two sets of terrain



samples. It was found that the Fourier features generally performed more poorly, while the other feature sets all performed comparably. (Author)

**A76-27150 \*** Soil water content and evaporation determined by thermal parameters obtained from ground-based and remote measurements. R. J. Reginato, S. B. Idso, R. D. Jackson (U.S. Department of Agriculture, Water Conservation Laboratory, Phoenix, Ariz.), J. F. Vedder, M. B. Blanchard (NASA, Ames Research Center, Moffett Field, Calif.), and R. Goettelman (LFE Corp., Richmond, Calif.). *Journal of Geophysical Research*, vol. 81, Mar. 20, 1976, p. 1617-1620. 9 refs. NASA Order S-53769-A.

Soil water contents from both smooth and rough bare soil were estimated from remotely sensed surface soil and air temperatures. An inverse relationship between two thermal parameters and gravimetric soil water content was found for Avondale loam when its water content was between air-dry and field capacity. These parameters, daily maximum minus minimum surface soil temperature and daily maximum soil minus air temperature, appear to describe the relationship reasonably well. These two parameters also describe relative soil water evaporation (actual/potential). Surface soil temperatures showed good agreement among three measurement techniques: in situ thermocouples, a ground-based infrared radiation thermometer, and the thermal infrared band of an airborne multi-spectral scanner. (Author)

**A76-27268** Optimum radar parameters for mapping soil moisture. F. T. Ulaby and P. P. Batlivala (University of Kansas Center for Research, Inc., Lawrence, Kan.). *IEEE Transactions on Geoscience Electronics*, vol. GE-14, Apr. 1976, p. 81-93. 13 refs.

The radar response to soil moisture content was experimentally determined for each of three bare fields with considerably different surface roughnesses at eight frequencies in the 2-8 GHz band for HH and VV polarizations. Analysis of the data indicates that the effect of roughness on the radar backscattering coefficient can be minimized by proper choice of the radar parameters. If, in addition, sensitivity to soil moisture content and system design constraints are considered, specific radar parameters are recommended for an operational soil moisture mapper. (Author)

**A76-27420** Timing of ground truth acquisition during remote assessment of soil-water content. R. D. Jackson, R. J. Reginato, and S. B. Idso (U.S. Department of Agriculture, Water Conservation Laboratory, Phoenix, Ariz.). *Remote Sensing of Environment*, vol. 4, no. 4, 1976, p. 249-255. 5 refs.

Remote sensing of soil-water content is, at present, limited to the top few centimeters of soil. During a diurnal cycle the near-surface water content undergoes rather wide diurnal fluctuations. Data from five experiments on Avondale loam at Phoenix, Arizona, at various times of the year demonstrated that soil samples taken between 1100 and 1200 hours (MST) best represented the 24 hour average soil-water content. Also, the average of the daily maximum and minimum water contents closely approximated the 24 hour average. The data showed that time of sampling was an important criterion when obtaining ground truth in remote sensing of soil-water content. (Author)

**A76-27421** On the variability of the reflected radiation field due to differing distributions of the irradiation. K. T. Kriebel (München, Universität, Munich, West Germany). *Remote Sensing of Environment*, vol. 4, no. 4, 1976, p. 257-264. 9 refs. Research sponsored by the Deutsche Forschungsgemeinschaft.

The directional reflected radiation of natural surfaces may change even if nothing save the distribution of the irradiation over the hemisphere varies. This is due to the angular anisotropy of the reflection properties of natural surfaces. The quantitative determination of this effect for four different vegetated surfaces is the aim of this investigation. Results are presented for the first of the four surfaces, a savannah. The directional reflected radiation may change by + or - 1% per degree change of the solar zenith angle and by + or - 1%

1% per 6% change of the spectral atmospheric turbidity factor at 0.52 micron. (Author)

**A76-27424** Fertilization of the Baltic by nitrogen fixation in the blue-green alga *Nodularia spumigena*. B. Ostrom (Fishery Board of Sweden, Hydrographic Dept., Goteborg, Sweden). *Remote Sensing of Environment*, vol. 4, no. 4, 1976, p. 305-310. 21 refs.

Blooms of phytoplankton are not uncommon in the Baltic and mass occurrence of *Nodularia spumigena* in July or August is often reported. However, not until satellite pictures were available, has the large extension been revealed. The Baltic, being a semienclosed basin under a heavy pollution load, has a delicate nutrient budget which has concerned chemists, biologists and ecologists, from different aspects. In this paper a rough estimation of the nitrogen fixation is given. This is a hitherto overlooked part of the nutrient budget, which has been brought to attention by means of remote sensing techniques. (Author)

**A76-27466** The change in the spectrum of a monochromatic wave when reflected from moving scatterers. N. A. Armand, V. A. Diakin, I. N. Kibardina, A. G. Pavel'ev, and V. D. Shuba. (*Radiotekhnika i Elektronika*, vol. 20, July 1975, p. 1337-1347.) *Radio Engineering and Electronic Physics*, vol. 20, July 1975, p. 1-9. 13 refs. Translation.

An experimental and theoretical study was conducted to evaluate the spectral variation of a monochromatic wave after its reflection from vegetation swaying under the action of the wind. The experiment was carried out in the 3-cm band. It is shown that the spectral power density of back-scattered radio waves decreases, at frequencies differing from the carrier frequency by 40 to 2500 Hz, according to a power law whose exponent varies between -3 and -6. No change is detected in the power of the reflected signal, whereas the power corresponding to the high-frequency portion of the spectrum (frequency range 40-2500 Hz) is found to increase proportionately to the fourth power of the wind speed. A theoretical model for deriving an expression for the spectral power density of a reflected signal is proposed. S.D.

**A76-27981 \*** Ground cover estimated from aerial photographs. A. H. Gerbermann, J. A. Cuellar, and C. L. Wiegand (U.S. Department of Agriculture, Weslaco, Tex.). *Photogrammetric Engineering and Remote Sensing*, vol. 42, Apr. 1976, p. 551-556. 8 refs. NASA Order R-09-038-002.

Estimates of per cent ground cover made by ground observers were compared with independent estimates made on the basis of low-altitude (640-1219 m) aerial photographs of the same fields. Standard statistical simple correlation and linear regression analyses revealed a high correlation between the two estimation methods. In crops such as grain, sorghum, corn, and forage sorghum, in which the broadest part of the leaf canopy is near the top of the plant, there was a tendency to overestimate the per cent ground cover from aerial photographs. C.K.D.

**A76-27982 \*** Monitoring wheat growth with radar. T. F. Bush (University of Kansas Center for Research, Inc., Lawrence, Kan.). *Photogrammetric Engineering and Remote Sensing*, vol. 42, Apr. 1976, p. 557-568. 20 refs. Contract No. NAS9-10261.

The scattering properties of wheat in the 8-18 GHz band were studied as a function of frequency, polarization, incidence angle, and crop maturity. Supporting ground truth was collected at the time of measurement. The data indicate the radar backscattering coefficient is sensitive to both radar system parameters and crop characteristics, particularly at incidence angles near nadir. Linear regression analysis of the backscattering coefficient (dB) on both time and plant moisture content result in rather good correlation, as high as 0.9, with the slope of these regression lines being 0.55 dB/day and -0.275 dB% plant moisture at 9.4 GHz at nadir. It is found that the coefficient undergoes rapid variations shortly before and after the

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wheat is harvested. Both of these analyses suggest methods for estimating wheat maturity and for monitoring the progress of harvest. (Author)

**A76-28058** Application of ERTS to rangeland management. E. L. Maxwell (Colorado State University, Fort Collins, Colo.). In: Remote sensing of earth resources. Volume 4 - Proceedings of the Fourth Annual Conference on Earth Resources, Tullahoma, Tenn., March 24-26, 1975. Tullahoma, University of Tennessee, 1975, p. 105-135. 19 refs. U.S. Geological Survey Contract No. 14-08-0001-13561.

This paper describes the successful results of a project designed to assess the usefulness of ERTS and other remote sensing systems as a rangeland management tool. A field measurement program supported and verified the successful use of ERTS imagery for computer classification of vegetation type, range condition and green biomass. Biomass classification was accomplished on three successive ERTS images without retraining the computer; indicating that biomass classification may be less critical than expected. Extensive statistical analysis of ERTS data has shown that the MSS Channel 5 and the ratio of Channel 7 to Channel 5 are by far the most significant variables for vegetation type and biomass classifications. Cross-classification results of vegetation type and biomass provide tables summarizing biomass availability by species groups and in total acres. A 1000-square-mile region was classified for computer costs of less than \$300.00, thereby verifying that a Remote Range Analysis System could soon be a practical and economic reality. (Author)

**A76-28059** Remote sensing techniques for wilderness and natural area planning. A. L. Sullivan (Duke University, Durham, N.C.). In: Remote sensing of earth resources. Volume 4 - Proceedings of the Fourth Annual Conference on Earth Resources, Tullahoma, Tenn., March 24-26, 1975. Tullahoma, University of Tennessee, 1975, p. 137-146. 12 refs.

The reservation of land from urban and agricultural development presently follows no plan. Spacecraft images of the earth's surface can be used to inventory potential wilderness areas and to assess their impact on one another. Conventional stereoscopic photography is adequate to the task of defining and locating natural areas. Both media are necessary to produce a dynamic model of unused land for planning purposes. Data for an island biogeographic model can be provided by such a two level remote sensing program. A product of the inventory and model is a plan or target for the preservation of wild lands. (Author)

**A76-28060** Differences in visible and near-infrared light reflectance between orange fruit and leaves. H. W. Gausman, D. E. Escobar, and A. Berumen (U.S. Department of Agriculture, Agricultural Research Service, Weslaco, Tex.). In: Remote sensing of earth resources. Volume 4 - Proceedings of the Fourth Annual Conference on Earth Resources, Tullahoma, Tenn., March 24-26, 1975. Tullahoma, University of Tennessee, 1975, p. 147-160. 13 refs. NASA Order R-09-038-002.

The objective was to find the best time during the season (April 26, 1972 to January 8, 1973) to distinguish orange fruit from leaves by spectrophotometrically determining at 10-day intervals when the difference in visible (550- and 650-nm wavelengths) and near-infrared (850-nm wavelength) light reflectance between fruit and nearby leaves was largest. December 5 to January 8 was the best time to distinguish fruit from leaves. During this period the fruit's color was rapidly changing from green to yellow, and the difference in visible light reflectance between fruit and leaves was largest. The difference in near-infrared reflectance between leaves and fruit remained essentially constant during ripening when the difference in visible light reflectance between leaves and fruit was largest. (Author)

**A76-28070** Factors controlling the application in agriculture of multichannel remote sensing surveys, with particular reference to the ERTS bandpasses. M. J. Duggin (Commonwealth

Scientific and Industrial Research Organization, Div. of Mineral Physics, Sydney, Australia), C. C. Curtain, N. Anderson (Commonwealth Scientific and Industrial Research Organization, Div. of Animal Health, Melbourne, Australia), and C. Yuan. In: Remote sensing of earth resources. Volume 4 - Proceedings of the Fourth Annual Conference on Earth Resources, Tullahoma, Tenn., March 24-26, 1975. Tullahoma, University of Tennessee, 1975, p. 301-316. 7 refs.

The method proposes uses ERTS imagery to measure the difference in reflection of various pasture and vegetation species on the earth's surface under various meteorological conditions. A series of measurements was made by this technique to study the maturation and 'drying off' of pasture species in Australia. The mean reflectance of grazed and ungrazed pasture was found to vary within 40% during spring and early summer. V.P.

**A76-28071** Snow and vegetation classification by means of digital Landsat-MSS data. K. Seidel (Eidgenössische Technische Hochschule, Zurich, Switzerland), R. Gfeller, and R. Binzegger (Zurich, Universität, Zurich, Switzerland). In: Remote sensing of earth resources. Volume 4 - Proceedings of the Fourth Annual Conference on Earth Resources, Tullahoma, Tenn., March 24-26, 1975. Tullahoma, University of Tennessee, 1975, p. 317-326.

A method for automated detection of snow cover and land use categories has been developed and used to evaluate areas in the Alps and Italy from digital Landsat MSS data. The linear discriminant analysis is used as a multivariate procedure to compute identification criteria stepwise within given levels of tolerance from carefully selected training cells. The decision rule in the program operates according to the maximum likelihood principle; each pixel is placed on the class of elements to which it has the shortest Mahalanobis distance. Each pixel is assigned to one training cell. Results are printed on photographic film which can be used in color overlay production. Satisfactory agreement with ground truth has been obtained. C.K.D.

**A76-28072 \*** Mapping forest vegetation with ERTS-1 MSS data and automatic data processing techniques. J. Messmore, G. E. Copeland, and G. F. Levy (Old Dominion University, Norfolk, Va.). In: Remote sensing of earth resources. Volume 4 - Proceedings of the Fourth Annual Conference on Earth Resources, Tullahoma, Tenn., March 24-26, 1975. Tullahoma, University of Tennessee, 1975, p. 327-344. 11 refs. Grant No. NGL-47-003-067.

This study was undertaken with the intent of elucidating the forest mapping capabilities of ERTS-1 MSS data when analyzed with the aid of LARS' automatic data processing techniques. The site for this investigation was the Great Dismal Swamp, a 210,000 acre wilderness area located on the Middle Atlantic coastal plain. Due to inadequate ground truth information on the distribution of vegetation within the swamp, an unsupervised classification scheme was utilized. Initially pictureprints, resembling low resolution photographs, were generated in each of the four ERTS-1 channels. Data found within rectangular training fields was then clustered into 13 spectral groups and defined statistically. Using a maximum likelihood classification scheme, the unknown data points were subsequently classified into one of the designated training classes. Training field data was classified with a high degree of accuracy (greater than 95%), and progress is being made towards identifying the mapped spectral classes. (Author)

**A76-28073** Multispectral imagery for detection of nutrient deficiencies in pine plantations. J. C. Rennie and D. H. Cress (Tennessee, University, Knoxville, Tenn.). In: Remote sensing of earth resources. Volume 4 - Proceedings of the Fourth Annual Conference on Earth Resources, Tullahoma, Tenn., March 24-26, 1975. Tullahoma, University of Tennessee, 1975, p. 345-355. 14 refs. Contract No. F19628-69-C-0016. Project THEMIS; AF Project 7259.

**A76-28075** Spruce budworm damage evaluations from color infrared photography. M. D. Ashley and J. Rea (Maine, University, Orono, Me.). In: Remote sensing of earth resources. Volume 4 - Proceedings of the Fourth Annual Conference on Earth Resources, Tullahoma, Tenn., March 24-26, 1975.  
Tullahoma, University of Tennessee, 1975, p. 387-401.  
11 refs. Research supported by the McIntire-Stennis and State appropriated funds.

**A76-28095** The effects of varying training set size on multispectral scanner data classification. G. E. Murine (Actron Industries, Inc., Monrovia, Calif.). In: Remote sensing of earth resources. Volume 4 - Proceedings of the Fourth Annual Conference on Earth Resources, Tullahoma, Tenn., March 24-26, 1975.  
Tullahoma, University of Tennessee, 1975, p. 743-758.

The results of applying the ACORN set of separation algorithms to a set of agricultural data collected by the conical ACTRON HMS multispectral point scanner are presented. The training sets selected were from an engineering test flight conducted in June 1971 over the Perris Valley in Southern California. The consistency test applied to the basic classification criteria was the 't' or 'Students' Distribution test. A nest of order four was used over a set of calculated consistency probabilities of .90, .95, .975 and .99. The conclusions are shown on three graphs which relate t-score to calculated probability or confidence score. B.J.

**N76-16507** Iowa State Univ. of Science and Technology, Ames. **MULTIPLE USE RESOURCE MANAGEMENT ON NATIONAL FORESTS VIA GOAL PROGRAMMING** Ph.D. Thesis  
Albert Thomas Schuler 1975 230 p  
Avail: Univ. Microfilms Order No. 76-1871

Multiple use resource management on public forest land presents complex, multi-criteria decision making problems to the public resource manager. The manager is in need of a practical decision model which will enable him to integrate the available information. The goal programming model was selected as a possible decision model to be used by the resource manager. The goal programming version differs from the linear programming model in the sense that weighted deviations from goals are minimized via goal programming. The conceptual feasibility of the goal programming model was tested via an application on the Swan Creek unit. Dissert. Abstr.

**N76-16510\*** Mekong Committee Secretariat, Bangkok (Thailand). **AGRICULTURE/FORESTRY HYDROLOGY Quarterly Report, Mar. 1975 - Nov. 1975**  
W. J. VanDerOord, Principal Investigator Dec. 1975 12 p  
Sponsored by NASA. Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S.D. 57198 ERTS  
(E76-10087; NASA-CR-145990) Avail: NTIS HC \$3.50 CSCL 08F

**N76-16523\*** Department of Agriculture, Washington, D.C. **AREA SAMPLING FRAME CONSTRUCTION FOR AN AGRICULTURE INFORMATION SYSTEM WITH LANDSAT-2 DATA Progress Report, 16 Jan. - 16 Jul. 1975**  
William H. Wigton, Principal Investigator Sep. 1975 10 p ERTS  
(E76-10100; NASA-CR-146033) Avail: NTIS HC \$3.50 CSCL 02C

**N76-16524\*** Department of Agriculture, Washington, D.C. **AREA SAMPLING FRAME CONSTRUCTION FOR AN AGRICULTURE INFORMATION SYSTEM WITH LANDSAT-2 DATA Progress Report, 17 Jul. - 17 Nov. 1975**

William H. Wigton, Principal Investigator Nov. 1975 3 p ERTS  
(E76-10101; NASA-CR-146034) Avail: NTIS HC \$3.50 CSCL 02C

**N76-16537\*** Mississippi State Office of Science and Technology, Jackson. **APPLICATION AND EVALUATION OF SATELLITE REMOTE SENSING DATA AND AUTOMATIC PROCESSING TECHNIQUES FOR STATE-WIDE LAND USE AND OTHER RESOURCE MANAGEMENT Progress Report, period ending 21 Oct. 1975**  
P. T. Bankston, Principal Investigator Oct. 1975 8 p ERTS  
(Contract NAS5-20918)  
(E76-10114; NASA-CR-146047) Avail: NTIS HC \$3.50 CSCL 08F

**N76-16540\*** Environmental Research Inst. of Michigan, Ann Arbor. **WHEAT PRODUCTIVITY ESTIMATES USING LANDSAT DATA Progress Report, 16 Aug. - 15 Nov. 1975**  
Richard F. Nalepka and John Colwell, Principal Investigators 18 Dec. 1975 5 p ERTS  
(Contract NAS5-22389)  
(E76-10117; NASA-CR-146050; ERIM-114800-8-L) Avail: NTIS HC \$3.50 CSCL 02C

The author has identified the following significant results. The biological leaf area index data show that there can be large variations in field vegetative condition from point to point. This is especially true in flood-irrigated fields, in which plant density (and development) varies drastically between rows that are in channels vs. those that are in raised areas. Considerable care must be used in interpreting the significance of isolated leaf area index measurements made from a single wheat row.

**N76-16541\*** Agriculture Dept., Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station. **EXTENSIVE INVENTORY OF FOREST RESOURCES BY MULTISTAGE SAMPLING Progress Report, 7 Sep. - 7 Dec. 1975**  
Robert C. Aldrich, Robert W. Dana, and Edwin H. Roberts, Principal Investigators 10 Dec. 1975 5 p ref ERTS  
(NASA Order S-54053-A)  
(E76-10118; NASA-CR-146051; PR-3) Avail: NTIS HC \$3.50 CSCL 02F

**N76-16544\*** National Aeronautics and Space Administration, John F. Kennedy Space Center, Cocoa Beach, Fla. **PLANNING APPLICATIONS IN EAST CENTRAL FLORIDA Progress Report, 12 Aug. - 11 Nov. 1975**  
John W. Hannah (Brevard County Planning Dept., Fla.), Garland L. Thomas, and Fernando Esparza, Principal Investigators 11 Nov. 1975 20 p ref ERTS  
(Contract NAS5-20907)  
(E76-10121; NASA-TM-X-72916) Avail: NTIS HC \$3.50 CSCL 08B

**N76-16546\*** Agricultural Research Service, Weslaco, Tex. **SOIL, WATER, AND VEGETATION CONDITIONS IN SOUTH TEXAS Quarterly Progress Report, 13 Oct. 1975 - 13 Jan. 1976**  
Craig L. Wiegand, Harold W. Gausman, Ross W. Leamer, and Arthur J. Richardson, Principal Investigators Jan. 1976 17 p refs ERTS  
(NASA Order S-53876-AG)  
(E76-10123; NASA-CR-146056) Avail: NTIS HC \$3.50 CSCL 08F

The author has identified the following significant results. Reflectance differences between the dead leaves of six crops (corn, cotton, sorghum, sugar cane, citrus, and avocado) and the respective bare soils where the dead leaves were lying on the ground were determined from laboratory spectrophotometric

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measurements over the 0.5- to 2.5 micron wavelength interval. The largest differences were in the near infrared waveband 0.75- to 1.35 microns. Leaf area index was predicted from plant height, percent ground cover, and plant population for irrigated and nonirrigated grain sorghum fields for the 1975 growing season.

**N76-16548\*#** Texas A&M Univ., College Station.

**APPLIED REGIONAL MONITORING OF THE VERNAL ADVANCEMENT AND RETROGRADATION (GREEN WAVE EFFECT) OF NATURAL VEGETATION IN THE GREAT PLAINS CORRIDOR** Progress Report, Aug. - Oct. 1975

John W. Rouse, Jr., Principal Investigator Nov. 1975 31 p refs ERTS

(Contract NAS5-20796)

(E76-10126; NASA-CR-146059; RSC-3018-3) Avail: NTIS HC \$4.00 CSCL 08F

**N76-16549\*#** Texas A&M Univ., College Station. Remote Sensing Center.

**APPLIED REGIONAL MONITORING OF THE VERNAL ADVANCEMENT AND RETROGRADATION (GREEN WAVE EFFECT) OF NATURAL VEGETATION IN THE GREAT PLAINS CORRIDOR** Progress Report, May - Jul. 1975

John W. Rouse, Jr., Principal Investigator Oct. 1975 21 p refs ERTS

(Contract NAS5-20796)

(E76-10127; NASA-CR-146060; RSC-3018-2) Avail: NTIS HC \$3.50 CSCL 08F

**N76-16550\*#** Bureau of Mineral Resources, Geology and Geophysics, Canberra (Australia).

**A STUDY OF THE USEFULNESS OF SKYLAB EREP DATA FOR EARTH RESOURCES STUDIES IN AUSTRALIA** Final Report

B. P. Lambert, M. L. Benson, C. J. Borough, B. J. Myers, C. E. Maffi, C. J. Simpson, W. J. Perry, K. L. Burns, J. Shepherd, R. Beattie, Principal Investigators et al Jul. 1975 113 p refs Sponsored by NASA and Dept. of Sci. and Consumer Affairs, Australia Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 EREP

(E76-10128; NASA-CR-144493) Avail: NTIS HC \$5.50 CSCL 05B

The author has identified the following significant results. In subhumid, vegetated areas, S190B photography: (1) has a potentially operational role in detecting lineaments in 1:100,000 scale geological mapping and in major civil engineering surveys; (2) is of limited value for regional lithological mapping at 1:500,000 scale; and (3) provided much useful synoptic information and some detailed information of direct value to the mapping of nonmineral natural resources such as vegetation, land soil, and water. In arid, well exposed areas, S190B photography could be used: (1) with a limited amount of field traverses, to produce reliable 1:500,000 scale geological maps of sedimentary sequences; (2) to update superficial geology on 1:250,000 scale maps; and (3) together with the necessary field studies, to prepare landform, soil, and vegetation maps at 1:1,000,000 scale. Skylab photography was found to be more useful than LANDSAT images for small scale mapping of geology and land types, and for the revision of topographic maps at 1:100,000 scale, because of superior spatial resolution and stereoscopic coverage.

**N76-16553\*#** Agricultural Research Service, Weslaco, Tex. **SOIL SALINITY DETECTION** Final Report, 13 Mar. 1973 - 31 Jul. 1975

Craig L. Wiegand, Arthur J. Richardson, Harold W. Gausman, Ross W. Leamer, Alvin H. Gerbermann, James H. Everitt, and Jose A. Cuellar, Principal Investigators Jul. 1975 50 p refs Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue,

Sioux Falls, S. D. 57198 EREP (NASA Order T-4105-B)

(E76-10131; NASA-CR-144403) Avail: NTIS HC \$4.00 CSCL 08M

The author has identified the following significant results. Growth forms and herbage biomass production varied considerably among saline and nonsaline soil range sites in Starr County. Grasses on saline soil sites were shallow-rooted and short whereas on nonsaline sites there was an intermixture of short and midgrass species. Differentiation between primarily undisturbed saline and nonsaline rangelands, in Starr County, is partially possible using film optical density readings from Skylab imagery. Differentiation among eight saline and nonsaline soil sites in Cameron County, using black and white and color film was not possible according to statistical results from both DMRT and correlation analysis. Linear analysis showed that Bendix 24-band MSS data (aircraft) collected at 1700 m and 4800 m, as well as Skylab and LANDSAT-1 MSS data, were significantly correlated to electrical conductivity readings. In Starr County, the best spectral band for detection of saline soil levels, using black and white SO-022 film, was in the 0.6 to 0.7 micron spectral region. In Cameron County, the best spectral bands for detection of saline soil levels were the 2.3 to 2.43 micron, 0.72 to 0.76 micron, 0.69 to 1.75 micron, and 0.7 to 1.1 micron spectral regions.

**N76-16556\*#** Kansas Univ. Center for Research, Inc., Lawrence, Atmospheric Science Lab.

**DETECTION OF SOIL MOISTURE AND SNOW CHARACTERISTICS FROM SKYLAB** Final Report

Joe R. Eagleman, Principal Investigator, Wen Lin, Norman Hardy, Richard Sloan, Surrenda Parashar, Charles Perry, Larry League, Margaret Engling, Ernest C. Pogge, and Richard K. Moore, Oct. 1975 313 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 EREP (Contract NAS9-13273)

(E76-10134; NASA-CR-144485; FR-239-23) Avail: NTIS HC \$9.75 CSCL 08M

The author has identified the following significant results. The most significant result is the good response of the passive radiometers, particularly the L-band radiometer, to changing soil moisture conditions near the surface of the earth. Radiometer response was very good for the five complete data sets consisting of three passes across Texas and two passes across Kansas. When data from the five different passes were combined, the correlation between the S194 radiometric temperature and soil moisture content remained high with a value of -0.96. The performance of the S193 passive radiometer was less consistent; however, one data set gave a very high correlation of -0.95. The scatterometer response to soil moisture at incidence angles near 30 deg was not as good as for the radiometers.

**N76-16557\*#** Earth Satellite Corp., Berkeley, Calif.

**PLAN FOR THE UNIFORM MAPPING OF EARTH RESOURCES AND ENVIRONMENTAL COMPLEXES FROM SKYLAB IMAGERY. ASSESSMENT OF NATURAL VEGETATION, ENVIRONMENTAL, AND CROP ANALOGS** Final Report

Charles E. Poulton, Principal Investigator and Robin I. Welch Dec. 1975 262 p refs Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 EREP (Contract NAS9-13286)

(E76-10135; NASA-CR-144484; G-089) Avail: NTIS HC \$9.00 CSCL 08B

The author has identified the following significant results. For interpreting a wide range of natural vegetation analogs, S-190A color infrared and the ERTS-1 color composite were consistently more useful than were conventional color or black and white photos. Color infrared was superior for five vegetation analogs while color was superior for only three. The errors in identification appeared to associate more with black and white single band images than with multiband color. For rice crop analogs, spectral and spatial discriminations both contribute to the usefulness of images for data collection. Tests and subjective

analyses conducted in this study indicated that the spectral bands exploited in color infrared film were the most useful for agricultural crop analysis. Accuracy of crop identification on any single date of Skylab images was less than that of multirate analysis due to differences in crop calendar, cultural practices used, rice variety, planting date, planting method, water use, fertilization, disease, or mechanical problems.

**N76-16558\*#** South Carolina State Development Board, Columbia. Div. of Geology.

**APPLICATION OF MULTISPECTRAL PHOTOGRAPHY TO MINERAL AND LAND RESOURCES OF SOUTH CAROLINA**  
**Final Report**

Norman K. Olson, Principal Investigator 27 Jun. 1975 76 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. EREP (Contract NAS8-29617) (E76-10136; NASA-CR-144109) Avail: NTIS HC \$5.00 CSCL 08F

The author has identified the following significant results. Good results were obtained from using Skylab photography in conjunction with LANDSAT imagery for visual interpretation of various geologic features, particularly lineaments. It was concluded that visual interpretation alone of Skylab photographs was quite limited, and much of this was because of the low contrast, heavily vegetated terrain in southeastern United States. Lineaments of major structural features are detectable but subtle. An intimate knowledge of the geologic field relationships is needed before a meaningful analysis is feasible using current satellite photography alone.

**N76-16598\*#** Bittinger (M. W.) and Associates, Inc., Fort Collins, Colo.

**SOIL MOISTURE GROUND TRUTH, LAFAYETTE, INDIANA, SITE; ST. CHARLES MISSOURI, SITE; CENTRALIA, MISSOURI, SITE**

E. Bruce Jones Dec. 1975 51 p (Contract NAS5-22312) (NASA-CR-144717) Avail: NTIS HC \$4.50 CSCL 08M

The soil moisture ground-truth measurements and ground-cover descriptions taken at three soil moisture survey sites located near Lafayette, Indiana; St. Charles, Missouri; and Centralia, Missouri are given. The data were taken on November 10, 1975, in connection with airborne remote sensing missions being flown by the Environmental Research Institute of Michigan under the auspices of the National Aeronautics and Space Administration. Emphasis was placed on the soil moisture in bare fields. Soil moisture was sampled in the top 0 to 1 in. and 0 to 6 in. by means of a soil sampling push tube. These samples were then placed in plastic bags and awaited gravimetric analysis. Author

**N76-16601\*#** Aeronutronic Ford Corp., Houston, Tex. Space Information Systems Operation.

**LARGE AREA CROP INVENTORY EXPERIMENT CROP ASSESSMENT SUBSYSTEM SOFTWARE REQUIREMENTS DOCUMENT**

26 Nov. 1975 102 p (Contract NAS9-1261) (NASA-CR-147417; USC-10009) Avail: NTIS HC \$5.50 CSCL 09B

The functional data processing requirements are described for the Crop Assessment Subsystem of the Large Area Crop Inventory Experiment. These requirements are used as a guide for software development and implementation. Author

**N76-17448\*#** Servicio Geologico de Bolivia, La Paz.  
**EARTH RESOURCE TECHNOLOGY SATELLITE (ERTS-A) SENSOR DATA FOR MINERAL RESOURCE SECTOR DEVELOPMENT AND USE SURVEY Progress Report, Jul. - Oct. 1975**

Carlos E. Brockman, Principal Investigator Oct. 1975 11 p Sponsored by NASA ERTS (E76-10139; NASA-CR-146148) Avail: NTIS HC \$3.50 CSCL 08G

**N76-17454\*#** Purdue Univ., Lafayette, Ind.  
**CROP IDENTIFICATION AND ACREAGE ESTIMATION OVER LARGE GEOGRAPHIC AREAS USING LANDSAT MSS DATA Quarterly Progress Report, 1 Oct. - 31 Dec. 1975**

Marvin E. Bauer, Principal Investigator 31 Dec. 1975 5 p ref ERTS (Contract NAS5-20793) (E76-10145; NASA-CR-146154) Avail: NTIS HC \$3.50 CSCL 02C

**N76-17470\*** Nebraska Univ., Lincoln. Conservation and Survey Div.

**ESTIMATING VEGETATIVE BIOMASS FROM LANDSAT-1 IMAGERY FOR RANGE MANAGEMENT**

Paul M. Seevers, James V. Drew, and Marvin P. Carlson /n NASA. Lyndon B. Johnson Space Center. NASA Earth Resources Survey Symp. Vol. 1-A: Agr., Environment Jun. 1975 p 1-8 refs (For availability see N76-17469 08-43) (A-1) CSCL 08F

Evaluation of LANDSAT-1, band 5 data for use in estimation of vegetative biomass for range management decisions was carried out for five selected range sites in the Sandhills region of Nebraska. Analysis of sets of optical density-vegetative biomass data indicated that comparisons of biomass estimation could be made within one frame but not between frames without correction factors. There was high correlation among sites within sets of radiance value-vegetative biomass data and also between sets, indicating comparisons of biomass could be made within and between frames. Landsat-1 data are shown to be a viable alternative to currently used methods of determining vegetative biomass production and stocking rate recommendations for Sandhills rangeland. Author

**N76-17471\*** Lockheed Electronics Co., Houston, Tex. Aerospace Systems Div.

**DISCRIMINATING COASTAL RANGELAND PRODUCTION AND IMPROVEMENTS WITH COMPUTER AIDED TECHNIQUES**

C. A. Reeves and D. P. Faulkner /n NASA. Lyndon B. Johnson Space Center. NASA Earth Resources Survey Symp. Vol. 1-A: Agr., Environment Jun. 1975 p 9-17 refs

(A-2) CSCL 08B

The feasibility and utility of using satellite data and computer-aided remote sensing analysis techniques to conduct range inventories were tested. This pilot study was focused over a 250,000 acre site in Galveston and Brazoria Counties along the Texas Gulf Coast. Rectified enlarged aircraft color infrared photographs of this site were used as the ground truth base. The different land categories were identified, delineated, and measured. Multispectral scanner (MSS) bulk data from LANDSAT-1 was received and analyzed with the Image 100 pattern recognition system. Features of interest were delineated on the image console giving the number of picture elements classified; the picture elements were converted to acreages and the accuracy of the technique was evaluated by comparison with data base results for three test sites. The accuracies for computer aided classification of coastal marshes ranged from 89% to 96%. Y.J.A.

**N76-17472\*** California Univ., Berkeley.  
**USEFULNESS OF LANDSAT DATA FOR MONITORING PLANT DEVELOPMENT AND RANGE CONDITIONS IN CALIFORNIA'S ANNUAL GRASSLAND**

David M. Carneggie (EROS Data Center, Sioux Falls, S.D.), Stephen D. DeGloria, and Robert N. Colwell /n NASA. Lyndon B. Johnson Space Center. NASA Earth Resources Survey Symp. Vol. 1-A: Agr., Environment Jun. 1975 p 19-41 refs

(A-3) CSCL 08F

A network of sampling sites throughout the annual grassland region of California was established to correlate plant growth stages and forage production to climatic and other environmental factors. Plant growth and range conditions were further related to geographic location and seasonal variations. A sequence of LANDSAT data was obtained covering critical periods in the growth cycle. This was analyzed by both photointerpretation and computer aided techniques. Image characteristics and spectral reflectance data were then related to forage production, range condition, range site and changing growth conditions. It was determined that repeat sequences with LANDSAT color composite images do provide a means for monitoring changes in range condition. Spectral radiance data obtained from magnetic tape can be used to determine quantitatively the critical stages in the forage growth cycle. A computer ratioing technique provided a sensitive indicator of changes in growth stages and an indication of the relative differences in forage production between range sites.

Author

**N76-17473\*** Texas A&M Univ., College Station.  
**MONITORING VEGETATION CONDITIONS FROM LANDSAT FOR USE IN RANGE MANAGEMENT**

R. H. Haas, D. W. Deering, J. W. Rouse, Jr., and J. A. Schell. In NASA. Lyndon B. Johnson Space Center. NASA Earth Resources Survey Symp. Vol. 1-A: Agr., Environment Jun. 1975 p 43-52

(A-4) CSCL 08F

A summary of the LANDSAT Great Plains Corridor projects and the principal results are presented. Emphasis is given to the use of satellite acquired phenological data for range management and agri-business activities. A convenient method of reducing LANDSAT MSS data to provide quantitative estimates of green biomass on rangelands in the Great Plains is explained. Suggestions for the use of this approach for evaluating range feed conditions are presented. A LANDSAT Follow-on project has been initiated which will employ the green biomass estimation method in a quasi-operational monitoring of range readiness and range feed conditions on a regional scale.

Author

**N76-17474\*** Kansas Univ., Lawrence. Space Technology Center.

**UTILIZATION OF LANDSAT IMAGERY FOR MAPPING VEGETATION ON THE MILLIONTH SCALE**

Donald L. Williams and Jerry C. Coiper. In NASA. Lyndon B. Johnson Space Center. NASA Earth Resources Survey Symp. Vol. 1-A: Agr., Environment Jun. 1975 p 53-65 refs

(Grant NGL-17-004-024)

(A-5) CSCL 08F

A series of test sites were examined to determine if the information content of the LANDSAT imagery that may be obtained of these sites is sufficient to permit their mapping according to the vegetation classification system recently published by Unesco. These sites include examples from the humid tropics, arid and semi-arid subtropics and temperature zones: Western Highlands of Papua New Guinea, Mindoro Island in the Philippines, Great Smoky Mountains of the southeastern United States, East Tennessee Valley, interior of Western Australia, northeastern Uganda, and south-central Kansas. The results of the experiment were presented in the form of vegetation maps and annotated images which serve to illustrate the detectability of various formations. It was concluded that, for the test sites examined, the formations of the Unesco vegetation classification can be satisfactorily distinguished on LANDSAT MSS images, especially when used as color composites and judiciously chosen as a season.

Author

**N76-17475\*** South Dakota State Univ., Brookings. Plant Science Dept.

**LANDSAT-1 DATA, ITS USE IN A SOIL SURVEY PROGRAM**

F. C. Westin and C. J. Frazee. In NASA. Lyndon B. Johnson Space Center. NASA Earth Resources Survey Symp. Vol. 1-A:

Agr., Environment Jun. 1975 p 67-95 refs

(A-6) CSCL 08M

The following applications of LANDSAT imagery were investigated: assistance in recognizing soil survey boundaries, low intensity soil surveys, and preparation of a base map for publishing thematic soils maps. The following characteristics of LANDSAT imagery were tested as they apply to the recognition of soil boundaries in South Dakota and western Minnesota: synoptic views due to the large areas covered, near-orthography and lack of distortion, flexibility of selecting the proper season, data recording in four parts of the spectrum, and the use of computer compatible tapes. A low intensity soil survey of Pennington County, South Dakota was completed in 1974. Low intensity inexpensive soil surveys can provide the data needed to evaluate agricultural land for the remaining counties until detailed soil surveys are completed. In using LANDSAT imagery as a base map for publishing thematic soil maps, the first step was to prepare a mosaic with 20 LANDSAT scenes from several late spring passes in 1973.

Author

**N76-17479\*** Lockheed Electronics Co., Houston, Tex.  
**TIMBER TYPE SEPARABILITY IN SOUTHEASTERN UNITED STATES ON LANDSAT-1 MSS DATA**

E. P. Kan and F. D. Dillman. In NASA. Lyndon B. Johnson Space Center. NASA Earth Resources Survey Symp. Vol. 1-A: Agr., Environment Jun. 1975 p 135-157 refs

(Contract NAS9-12200)

(A-11) CSCL 02F

A quantitative, computer-aided study was made on the spectral separability of timber types and condition classes in the Southeastern United States, using LANDSAT-1 multispectral scanner data. It was concluded that LANDSAT-1 could be used effectively to discriminate the gross forest features of softwood, hardwood, and regeneration. The only significant detectable age difference would be between an established forest versus a young (or denuded) forest. The red or near infrared bands would be better for discrimination; phenological early and late spring data would be better than winter. And a temporal analysis would be superior to single-season analysis. Lastly, two spectral bands would be most cost effective for computer analysis. The study site was Sam Houston National Forest of East Texas, a typical forest in the Flatwoods Zone, Southern Region, U. S. Forest Service.

Author

**N76-17480\*** California Univ., Berkeley.  
**MAPPING OF THE WILDLAND FUEL CHARACTERISTICS OF THE SANTA MONICA MOUNTAINS OF SOUTHERN CALIFORNIA**

J. D. Nichols. In NASA. Lyndon B. Johnson Space Center. NASA Earth Resources Survey Symp. Vol. 1-A: Agr., Environment Jun. 1975 p 159-166

(A-12) CSCL 08B

LANDSAT digital data was successfully used to map and evaluate the wildland fuels of the Santa Monica Mountains in Southern California. A mixed classification scheme was used where training areas of known vegetation types were entered and the maximum likelihood classifier run, followed by an evaluation of the results and an unsupervised retraining of the classifier using an image of the probability of misclassification. Estimation of maturity class and crown closure percents of the major cover types were assigned to each computer class by associating the photointerpretation of 159 large scale photo samples with the resultant computer classes using analysis of variance and analysis of categorized data. The result of the computer classification and statistical analysis were then transformed from the LANDSAT Coordinate California State Plane Coordinate system for use in a digital format in the FIRESCOPE data retrieval and fire modeling system.

Author

**N76-17483\*** Agricultural Research Service, Weslaco, Tex.  
**THE USE OF SKYLAB DATA TO STUDY THE EARLY**

Southern Region Citrus Insects Research.

## 01 AGRICULTURE AND FORESTRY

worms in areas where screwworms breed. The reproduction of the screwworm can be more or less predicted based on weather conditions -- cold weather slows the breeding, warm weather fosters it, and some moisture appears to enhance breeding conditions which, in turn, improves the chances of screwworm population growth. To obtain temperature and moisture conditions from remote areas, the NOAA improved TIROS operational satellite was selected to give data from the very high resolution radiometer (VHRR). The VHRR is a two-channel scanning instrument sensitive to energy in the visible spectrum from 0.6 to 0.7 micrometers and the infrared spectrum from 10.5 to 12.5 micrometers.

Author

**N76-17569\*** Texas A&M Univ., College Station.  
**THREE EXAMPLES OF APPLIED REMOTE SENSING OF VEGETATION**

J. W. Rouse, Jr., A. R. Benton, Jr., R. W. Toler, and R. H. Haas /*In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975 p 1797-1810

(Grant NGL-44-001-001)

(L-19) Avail: NTIS CSCL 08F

Cause studies in which remote sensing techniques were adapted to assist in the solution of particular problem situations in Texas involving vegetation are described. In each case, the final sensing technique developed for operational use by the concerned organizations employed photographic sensors which were optimized through studies of the spectral reflectance characteristics of the vegetation species and background conditions unique to the problem being considered. The three examples described are: (1) Assisting Aquatic Plant Monitoring and Control; (2) Improving Vegetation Utilization in Urban Planning; and (3) Enforcing the Quarantine of Diseased Crops.

Author

**N76-17581\*** National Marine Fisheries Service, Bay Saint Louis, Miss.

**THE FEASIBILITY OF UTILIZING REMOTELY SENSED DATA TO ASSESS AND MONITOR OCEANIC GAMEFISH**

Kenneth J. Savastano and Thomas D. Leming /*In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975 p 2023-2062 refs

(M-8) CSCL 08A

An investigation was conducted to establish the feasibility of utilizing remotely sensed data acquired from aircraft and satellite platforms to provide information concerning the distribution and abundance of oceanic gamefish. The data from the test area was jointly acquired by NASA, the Navy, the Air Force and NOAA/NMFS elements and private and professional fishermen in the northeastern Gulf of Mexico. The data collected has made it possible to identify fisheries significant environmental parameters for white marlin. Prediction models, based on catch data and surface truth information, were developed and demonstrated a potential for significantly reducing search by identifying areas that have a high probability of productivity. Three of the parameters utilized by the models, chlorophyll-a, sea surface temperature, and turbidity were inferred from aircraft sensor data and were tested. Effective use of Skylab data was inhibited by cloud cover and delayed delivery. Initial efforts toward establishing the feasibility of utilizing remotely sensed data to assess and monitor the distribution of oceanic gamefish has successfully identified fisheries significant oceanographic parameters and demonstrated the capability of remotely measuring most of the parameters.

Author

**N76-17587\*** National Aeronautics and Space Administration, Earth Resources Labs., Bay St. Louis, Miss.  
**THE MAPPING OF MARSH VEGETATION USING AIRCRAFT MULTISPECTRAL SCANNER DATA**

M. Kristine Butera /*In* its NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975 p 2147-2166 refs

(M-14) CSCL 08F

A test was conducted to determine if salinity regimes in coastal marshland could be mapped and monitored by the identification and classification of marsh vegetative species from aircraft multispectral scanner data. The data was acquired at 6.1 km (20,000 ft.) on October 2, 1974, over a test area in the coastal marshland of southern Louisiana including fresh, intermediate, brackish, and saline zones. The data was classified by vegetational species using a supervised, spectral pattern recognition procedure. Accuracies of training sites ranged from 67% to 96%. Marsh zones based on free soil water salinity were determined from the species classification to demonstrate a practical use for mapping marsh vegetation.

Author

**N76-17592\*** National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

**MICROWAVE REMOTE SENSING OF SOIL MOISTURE**

Fawwaz T. Ulaby (Kansas Univ., Lawrence), Percy P. Batlivala (Kansas Univ., Lawrence), Josef Cihlar (Kansas Univ., Lawrence), and Thomas Schmugge /*In* its NASA Earth Resources Surv. Symp., Vol. 1-D Jun. 1975 p 2207-2232 refs

(W-5) CSCL 08M

The potential application of microwave remote sensing devices in estimating soil moisture content over extended areas was examined. Experimental measurements involving both active and passive microwave sensors acquired from a variety of platforms are presented.

Author

**N76-17593\*** Kansas Univ., Lawrence.

**SOIL MOISTURE DETECTION FROM SKYLAB**

Joe R. Eagleman and Wen C. Lin /*In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-D Jun. 1975 p 2233-2241 refs

(W-6) CSCL 08M

An investigation was designed for the Skylab satellite to determine the feasibility of remote sensing of the soil moisture content of the surface from various microwave sensors. Skylab data for the experiment were collected during passes 5, 10, 16, and 38 across the two test sites selected in eastern Kansas and western Texas. Pass 38 covered both test sites giving five data sets for the analysis. As Skylab data were being taken the moisture content of the soil was sampled by ground crews for each 2.5 centimeter depth from the surface to 15 centimeters at interval of about six kilometers along two different routes along the test sites. This resulted in a total of 2250 soil moisture samples corresponding to different locations and six different depths. Skylab data were collected by passive microwave radiometers at wavelengths of 2.1 and 21 centimeters by the S193 and S194 microwave sensors. An active microwave system also collected scatterometer data at a wavelength of 2.1 centimeters. The analysis of microwave data has revealed that the longer wavelength L-Band passive radiometer gives the best correlation with soil moisture content of the upper 2.5 centimeter depth of soil.

Author

**N76-17607\*** South Dakota State Univ., Brookings. Remote Sensing Inst.

**EVALUATION OF THERMAL X/5-DETECTOR SKYLAB S-192 DATA FOR ESTIMATING EVAPOTRANSPIRATION AND THERMAL PROPERTIES OF SOILS FOR IRRIGATION MANAGEMENT**

D. G. Moore, M. L. Horton, M. J. Russell, and V. I. Myers /*In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-D Jun. 1975 p 2561-2583 refs

(Contract NAS9-13337)

(W-21) SDSU-RSI-J-75-03) CSCL 08M

An energy budget approach to evaluating the SKYLAB X/5-detector S-192 data for prediction of soil moisture and evapotranspiration rate was pursued. A test site which included both irrigated and dryland agriculture in Southern Texas was selected for the SL-4 SKYLAB mission. Both vegetated and fallow

**DETECTION OF INSECT INFESTATIONS AND DENSITY AND DISTRIBUTION OF HOST PLANTS**

W. G. Hart, S. J. Ingle, and M. R. Davis /In NASA. Lyndon B. Johnson Space Center. NASA Earth Resources Survey Symp. Vol. 1-A: Agr. Environment Jun. 1975 p 203-219 refs

**(A-15) CSCL 08C**

The detection of insect infestations and the density and distribution of host plants were studied using Skylab data, aerial photography and ground truth simultaneously. Additional ground truth and aerial photography were acquired between Skylab passes. Three test areas were selected: area 1, of high density citrus, was located northwest of Mission, Texas; area 2, 20 miles north of Weslaco, Texas, irrigated pastures and brush-covered land; area 3 covered the entire Lower Rio Grande Valley and adjacent areas of Mexico. A color composite picture of S-190A data showed patterns of vegetation on both sides of the Rio Grande River clearly delineating the possible avenues of entry of pest insects from Mexico into the United States or from the United States into Mexico. Vegetation that could be identified with conventional color and color IR film included: citrus, brush, sugarcane, alfalfa, irrigated and unimproved pastures. Author

**N76-17484\*** General Electric Co., Beltsville, Md. Space Systems Organization.

**AGRICULTURAL INVENTORY CAPABILITIES OF MACHINE PROCESSED LANDSAT DIGITAL DATA**

David L. Dietrick, Ronald E. Fries, and Dwight D. Egbert /In NASA. Lyndon B. Johnson Space Center. NASA Earth Resources Survey Symp. Vol. 1-A: Agr., Environment Jun. 1975 p 221-232 refs

**(A-16) CSCL 02C**

Agricultural crop identification and acreage determination analysis of LANDSAT digital data was performed for two study areas. A multispectral image processing and analysis system was utilized to perform the man-machine interactive analysis. The developed techniques yielded crop acreage estimate results with accuracy greater than 90% and as high as 99%. These results are encouraging evidence of agricultural inventory capabilities of machine processed LANDSAT digital data. Author

**N76-17485\*** General Electric Co., Beltsville, Md.

**AGRICULTURAL APPLICATIONS OF REMOTE SENSING: A TRUE LIFE ADVENTURE**

Earle S. Schaller /In NASA. Lyndon B. Johnson Space Center. NASA Earth Resources Survey Symp. Vol. 1-A: Agr., Environment Jun. 1975 p 233-238

**(A-17) CSCL 02C**

A study of agricultural applications of remote sensing with a major US agricultural firm was undertaken in mid-1973. The study continued for eighteen months, and covered the areas of crop monitoring and management as well as large scale crop inventories. Pilot programs in the application of aircraft remote sensing and LANDSAT data were conducted. An operational aircraft survey program for ranch management has subsequently been implemented by the agricultural firm. LANDSAT data was successfully used to produce a ninety-seven percent accurate inventory of cotton over 4.8 million acres of California's San Joaquin Valley. Author

**N76-17486\*** Anderson, Clayton and Co., Houston, Tex.

**PRACTICAL APPLICATION OF REMOTE SENSING IN AGRICULTURE**

Richard A. Phelps /In NASA. Lyndon B. Johnson Space Center. NASA Earth Resources Survey Symp. Vol. 1-A: Agr., Environment Jun. 1975 p 239-242 refs

**(A-18) CSCL 02C**

Remote sensing program imagery from several types of platforms, from light aircraft to the LANDSAT (ERTS) satellites, have been utilized during the past few years, with preference for inexpensive imagery over expensive magnetic tapes. Emphasis has been on practical application of remote sensing data to increase crop yield by decreasing plant stress, disease, weeds and undesirable insects and by improving irrigation. Imagery obtained from low altitudes via aircraft provides the necessary

resolution and complements but does not replace data from high altitude aircraft, Gemini and Apollo spacecraft, Skylab space station and LANDSAT satellites. Federal government centers are now able to supply imagery within about thirty days from data of order. Nevertheless, if the full potential of space imagery in practical agricultural operations is to be realized, the time span from date of imaging to user application needs to be shortened from the current several months to not more than two weeks.

Author

**N76-17487\*** Texas Parks and Wildlife Dept., Austin.

**WILDLIFE MANAGEMENT BY HABITAT UNITS: A PRELIMINARY PLAN OF ACTION**

Carl D. Frentress and Roy G. Frye /In NASA. Lyndon B. Johnson Space Center. NASA Earth Resources Survey Symp. Vol. 1-A: Agr., Environment Jun. 1975 p 245-262 refs

**(E-1) CSCL 06C**

Procedures for yielding vegetation type maps were developed using LANDSAT data and a computer assisted classification analysis (LARSYS) to assist in managing populations of wildlife species by defined area units. Ground cover in Travis County, Texas was classified on two occasions using a modified version of the unsupervised approach to classification. The first classification produced a total of 17 classes. Examination revealed that further grouping was justified. A second analysis produced 10 classes which were displayed on printouts which were later color-coded. The final classification was 82 percent accurate. While the classification map appeared to satisfactorily depict the existing vegetation, two classes were determined to contain significant error. The major sources of error could have been eliminated by stratifying cluster sites more closely among previously mapped soil associations that are identified with particular plant associations and by precisely defining class nomenclature using established criteria early in the analysis.

Author

**N76-17489\*** Lockheed Electronics Co., Houston, Tex.

**THE RATIONALE FOR ATTEMPTING TO DEFINE SALT MARSH MOSQUITO-BREEDING AREAS IN GALVESTON COUNTY BY REMOTE SENSING THE ASSOCIATED VEGETATION**

Gerald K. Arp /In NASA. Lyndon B. Johnson Space Center. NASA Earth Resources Survey Symp. Vol. 1-A: Agr., Environment Jun. 1975 p 289-299 refs

**(E-3) CSCL 06C**

The rationale for attempting to define salt marsh mosquito breeding areas in Galveston County was discussed, including a botanical survey of the marsh plant communities, their relationship to flooding, and their exposure to salt water. Particular emphasis is given to *Distichlis spicata*, a widespread marsh grass. Evidence suggests that breeding areas of *Aedes sollicitans* are associated with *Distichlis* and that both species respond to similar ecological conditions in the salt marsh. Aspects of the remote sensing of the *Distichlis* are considered.

Author

**N76-17537\*** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

**THE SCREWORM ERADICATION DATA SYSTEM (SEDS)**

Matthew J. Quinn /In its NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 1309-1312

**(I-13) CSCL 05B**

One of the objectives of the SEDS was to build a versatile, yet economical, interactive system on the existing digital PDP 11/45 computers used in the Skylab production processing system. Previous experience on various interactive systems gave some background in the best methods of handling image data, registering and correcting the data, and extracting useful information from the images. The screwworm was eliminated in many parts of the United States by air-dropping sterile screw-



fields were included. Data for a multistage analysis including ground, NC-130B aircraft, RB-57F aircraft, and SKYLAB altitudes were collected. The ground data included such measurements as gravimetric soil moisture, percent of the ground covered by green vegetation, soil texture, net radiation, soil temperature gradients, surface emittance, soil heat flux, air temperature and humidity gradients, and cultural practices. Ground data were used to characterize energy budgets and to evaluate the utility of an energy budget approach for determining soil moisture differences among twelve specific agricultural fields. Author

**N76-17614\*** Cargill, Inc., Minneapolis, Minn.

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Richard Baldwin / In NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 3 Jun. 1975 p 1-3

#### CSCL 02C

Applications of remote sensing in the areas of crop identification, range management, forest management and soil mapping are summarized. D.M.L.

**N76-18584\*#** California Univ., Berkeley. Space Sciences Lab.

#### AGRICULTURAL INTERPRETATION TECHNIQUE DEVELOPMENT Final Report, 1 Jun. 1973 - 31 Jul. 1975

Robert N. Colwell, Principal Investigator, Andrew S. Benson, Catherine E. Brown, Claire M. Hay, David M. Huston, Nancy A. Jones, James D. Nichols, and Randall W. Thomas 31 Jul. 1975 258 p refs Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 EREP (Contract NAS9-14419)

(E76-10163; NASA-CR-144486; SSL-Ser-16-Issue-77) Avail: NTIS HC \$9.00 CSCL 02C

The author has identified the following significant results. Highly useful agricultural land use classifications can be accomplished on S-190 A and B photography. Of the two film types available, viz., natural color and false color infrared, false color infrared photography was found to be the more useful for determining stratification units. Through the use of point sampling techniques on both single and multistate S-190A false color infrared photography, estimates were made of irrigated lands on four test sites in the San Joaquin Valley, California. A multistate photointerpretation technique was developed to inventory cotton with S-190A and S-190B photography from the Skylab 2 and 3 missions. The photographic point sample plan and estimation models were designed so that their most efficient applications would be for organizations with limited automatic processing facilities. The S-192 data from the three Skylab missions were analyzed using the CALSCAN program to determine the optimum four-channel combinations for classifying agricultural crops in the San Joaquin Valley. Based on the results, it was concluded that the optimum feature combination for classifying the agricultural complex in California would be features 4, 7, 9, and 11.

#### **N76-18605\*#** Houston Univ., Tex. Wave Propagation Lab. CROSS-CORRELATIVE ANALYSIS OF S-193 DATA FOR TERRAIN CHARACTERISTICS Final Report

H. S. Hayre, Principal Investigator 15 Aug. 1975 39 p EREP

(Contract NAS9-13462)

(E76-10184; NASA-CR-144501; TR-75-9) Avail: NTIS HC \$4.00 CSCL 08B

The author has identified the following significant results. The impulse response technique, when coupled with fine resolution altimeter data, is capable of yielding: (1) very fine mean ground elevation resolution; (2) slopes and slope variation along the altimeter path; (3) the absorption or the ground vegetation cover density for a given weather condition; and (4) an eventual classification of ground cover and/or moisture content of the ground.

**N76-18619\*#** Delaware Univ., Newark. Coll. of Marine Studies.

#### DYNAMICS OF PLANKTON POPULATIONS IN UPWELLING AREAS Final Report, 19 Mar. 1973 - 21 Jul. 1975

Karl-Heinz Szekiella, Principal Investigator 31 Jul. 1975 239 p refs Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 EREP

(Contract NAS9-13344)

(E76-10207; NASA-CR-144480; CMS-NASA-C-1-75) Avail: NTIS HC \$8.00 CSCL 08A

The author has identified the following significant results. Spectral properties of the upwelled waters off the NW coast of Africa were studied with observations derived from aircraft and Skylab. Results indicate that the two-channel, ratio approach is ineffective in determining surface chlorophyll concentrations. Ocean color boundaries and temperature gradients were found to be directly correlated with each other and also with fishing effort in the upwelling region. Photographic and scanner data derived from Skylab were effective in locating ocean boundaries and mapping temperature distributions.

#### **N76-18622\*#** Instituto de Pesquisas Espaciais, Sao Paulo (Brazil). COLLECTION OF RELEVANT RESULTS OBTAINED WITH THE SKYLAB IMAGES BY THE INSTITUTE FOR SPACE RESEARCH, INPE Final Report

Fernando DeMendonca, Principal Investigator, Joao Botelho Machado, Antonio T. Tardin, Natalio F. Koffler, Nilton T. Higa, Hardy Jost, Renato Herz, Eric R. Stoner, Jose Carlos Maia, and Ravindra Kumar Dec. 1975 95 p refs Sponsored by NASA. Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(E76-10211; NASA-CR-147502; INPE-793-NTE/043) Avail: NTIS HC \$5.00 CSCL 08B

**N76-18624\*#** National Academy of Sciences - National Research Council, Washington, D.C.

#### AGRICULTURE, FOREST, AND RANGE Practical Applications of Space Systems

1975 57 p refs

(Contract NSR-09-012-106)

(NASA-CR-146405; Paper-4) Avail: NTIS HC \$4.50; Space Applications Board, National Research Council, 2101 Constitution Avenue, N. W., Washington, D. C. 20418 CSCL 02C

The findings and recommendations of the panel for developing a satellite remote-sensing global information system in the next decade are reported. User requirements were identified in five categories: (1) cultivated crops, (2) land resources, (3) water resources, (4) forest management, and (5) range management. The benefits from the applications of satellite data are discussed. F.O.S.

**N76-19510\*#** California Univ., Berkeley. Space Sciences Lab.

#### AN INVENTORY OF IRRIGATED LANDS WITHIN THE STATE OF CALIFORNIA BASED ON LANDSAT AND SUPPORTING AIRCRAFT DATA Quarterly Progress Report, 15 Oct. 1975 - 25 Jan. 1976

Robert N. Colwell, Principal Investigator, Sharon Wall, and Dennis Noren 25 Jan. 1976 17 p ref ERTS

(Contract NAS5-20969)

(E76-10202; NASA-CR-146299; SSL-Ser-17-Issue-6) Avail: NTIS HC \$3.50 CSCL 08B

**N76-19512\*#** Pacific Southwest Forest and Range Experiment Station, Berkeley, Calif.

#### EVALUATION OF SKYLAB (EREP) DATA FOR FOREST AND RANGELAND SURVEYS Final Report

Robert C. Aldrich, Principal Investigator, Robert W. Dana, Wallace J. Greentree, Edwin H. Roberts, Nancy X. Norick, Thomas H. Waite, Richard E. Francis (Rocky Mountain Forest and Range

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Experiment Station, Fort Collins, Colo.), Richard S. Driscoll (Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colo.), and Frederick P. Weber 1 Dec. 1975 282 p refs Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 EREP (NASA Order T-4106-B) (E76-10204; NASA-CR-147440) Avail: NTIS HC \$9.25 CSCL 08F

The author has identified the following significant results. Four widely separated sites (near Augusta, Georgia; Lead, South Dakota; Manitou, Colorado; and Redding, California) were selected as typical sites for forest inventory, forest stress, rangeland inventory, and atmospheric and solar measurements, respectively. Results indicated that Skylab S190B color photography is good for classification of Level 1 forest and nonforest land (90 to 95 percent correct) and could be used as a data base for sampling by small and medium scale photography using regression techniques. The accuracy of Level 2 forest and nonforest classes, however, varied from fair to poor. Results of plant community classification tests indicate that both visual and microdensitometric techniques can separate deciduous, coniferous, and grassland classes to the region level in the Ecoclass hierarchical classification system. There was no consistency in classifying tree categories at the series level by visual photointerpretation. The relationship between ground measurements and large scale photo measurements of foliar cover had a correlation coefficient of greater than 0.75. Some of the relationships, however, were site dependent.

**N76-19522\*#** Federal Geological Survey, Hanover (West Germany).

### **HYDROGEOLOGICAL INVESTIGATIONS IN THE PAMPA OF ARGENTINA Final Report**

Dieter Bannert, H. Bender, W. Kantor, and W. Kruck, Principal Investigators May 1975 19 p refs Sponsored by NASA and Bundesanstalt fuer Geowissenschaften und Rohstoffe, West Germany Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS (E76-10219; NASA-CR-144488) Avail: NTIS HC \$3.50 CSCL 08G

The author has identified the following significant results. Satellite imagery in combination with ground investigations allows the identification and delineation of the near surface ground water (depth to ground water, salinity). The degree of precision achieved is greater than that obtainable by conventional ground survey methods alone.

**N76-19525\*#** National Marine Fisheries Service, Bay Saint Louis, Miss.

### **APPLICATION OF REMOTE SENSING FOR FISHERY RESOURCES ASSESSMENT AND MONITORING Final Report**

K. J. Savastano, Principal Investigator Oct. 1975 92 p refs Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 EREP (NASA Order T-8217-B) (E76-10222; NASA-CR-147507; MARMAP-105) Avail: NTIS HC \$5.00 CSCL 08A

The author has identified the following significant results. The distribution and abundance of white marlin correlated with the chlorophyll, water temperature, and Secchi depth sea truth measurements. Results of correlation analyses for dolphin were inconclusive. Prediction models for white marlin were developed using stepwise multiple regression and discriminant function analysis techniques which demonstrated a potential for increasing the probability of game fishing success. The S190A and B imagery was density sliced/color enhanced with white marlin location superimposed on the image, but no density/white marlin relationship could be established.

### **N76-19532\*# Kanner (Leo) Associates, Redwood City, Calif. USE OF REMOTE SENSORS IN MAPPING THE VEGETATION OF VERACRUZ**

M. Soto, A. Comez-Pompa, F. Menendez, G. Arp, M. A. Acosta, and G. Ramos Washington NASA Mar. 1976 9 p Transl. into ENGLISH of "Uso de Sensores Remotos en el Mapa de Vegetacion de Veracruz" (unpublished report) Mexico City, Inst. of Biol., Mexico Univ., 1976 p 1-8 Original contains color illustrations

(Contract NASw-2790)

(NASA-TT-F-16942) Avail: NTIS HC \$3.50 CSCL 08F

The vegetation of the State of Veracruz, Mexico, is mapped by means of remote sensor techniques. The images used are those of the ERTS II satellite, and the ground support is provided by field studies already conducted. The purpose is to evaluate remote sensor techniques and to have a good map reflecting both the potential vegetation, as well as the actual vegetation of the area. Author

**N76-19534\*#** Bittering (M. W.) and Associates, Inc., Fort Collins, Colo.

### **SOILS MAPS SUPPLEMENT TO SOIL MOISTURE GROUND TRUTH, LAFAYETTE, INDIANA, SITE ST. CHARLES, MISSOURI, SITE Mission Report, 10 Nov. 1975**

E. Bruce Jones and Stephen E. Olt 10 Nov. 1975 14 p refs (Contract NAS5-22312)

(NASA-CR-144732) Avail: NTIS HC \$3.50 CSCL 08B

A compilation of soils information obtained as the result of a library search of data on the Lafayette, Indiana, site and St. Charles, Missouri, site is presented. Soils data for the Lafayette, Indiana, site are shown in Plates 1 and 2; and soils data for the St. Charles, Missouri, site are shown in Plates 3 and 4. Author

**N76-19540\*#** National Aeronautics and Space Administration, Lyndon B. Johnson Space Center, Houston, Tex.

### **APPLICATION OF REMOTELY SENSED MULTISPECTRAL DATA TO AUTOMATED ANALYSIS OF MARSHLAND VEGETATION. INFERENCE TO THE LOCATION OF BREEDING HABITATS OF THE SALT MARSH MOSQUITO (AEDES SOLICITANS)**

William G. Cibula Feb. 1976 36 p refs Original contains color illustrations

(NASA-TN-D-8139; JSC-S-373) Avail: NTIS HC \$4.00 CSCL 08F

The techniques used for the automated classification of marshland vegetation and for the color-coded display of remotely acquired data to facilitate the control of mosquito breeding are presented. A multispectral scanner system and its mode of operation are described, and the computer processing techniques are discussed. The procedures for the selection of calibration sites are explained. Three methods for displaying color-coded classification data are presented. Author

**N76-19767#** American Inst. of Biological Sciences, Arlington, Va.

### **WORKSHOP ON PROBLEMS OF ASSESSING POPULATIONS OF NEKTON Final Report**

W. G. Percy 1 Aug. 1975 36 p refs Workshop held at Santa Barbara, Calif., 25-27 Feb. 1975

(Contract N00014-70-A-0140-0003; NR Proj. 104-008)

(AD-A016245; ONR-ACR-211) Avail: NTIS CSCL 08/1

A workshop was held in Santa Barbara, California, to discuss problems associated with assessing the populations of nekton or strongly swimming animals such as squids, shrimps and fishes. Sessions were held to discuss four major methods of assessing nekton populations: (1) Net collections, (2) Acoustics, (3) Egg/larval surveys, (4) Visual methods, remote sensing and feeding habit studies. An attempt was made to review the state of the art for each method including advantages, disadvantages and an evaluation of the accuracy of assessment. In addition,

an attempt was made to identify important scientific problems and to recommend areas for future research and development.

GRA

**N76-20578\*#** Alaska Univ., Fairbanks. Alaska Cooperative Wildlife Research Unit.

**USE OF LANDSAT IMAGERY FOR WILDLIFE HABITAT MAPPING IN NORTHEAST AND EASTCENTRAL ALASKA**

Progress Report

Peter C. Lent, Principal Investigator. 8 Mar. 1976 4 p ref ERTS

(Contract NAS5-20915)

(E76-10227; NASA-CR-146431; PR-3) Avail: NTIS HC 3.50 CSCL 06C

The author has identified the following significant results. Winter and summer moose range maps of three selected areas were produced (1:63,360 scale). The analytic approach is very similar to modified clustering. Preliminary results indicate that this method is not only more accurate but considerably less expensive than supervised classification techniques.

**N76-20582\*#** Environmental Research Inst. of Michigan, Ann Arbor.

**WHEAT PRODUCTIVITY ESTIMATES USING LANDSAT DATA** Progress Report, 16 Nov. 1975 - 15 Feb. 1976

Richard F. Nalepka, John Colwell, Principal Investigators, and Daniel P. Rice 15 Feb. 1976 24 p refs ERTS

(Contract NAS5-22389)

(E76-10232; NASA-CR-146515; ERIM-114800-12-L) Avail: NTIS HC \$3.50 CSCL 02C

**N76-20599\*#** California Univ., Berkeley. Space Sciences Lab.

**APPLICATION OF PHOTOINTERPRETATIVE TECHNIQUES TO WHEAT IDENTIFICATION, SIGNATURE EXTENSION, AND SAMPLING STRATEGY** Quarterly Progress Report, 16 Aug. - 15 Nov. 1975

R. N. Calwell, Principal Investigator, C. M. Hay, and R. W. Thomas 29 Jan. 1976 63 p Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 EREP (Contract NAS9-14565)

(E76-10252; NASA-CR-147506; SSL-Ser-17-Issue-3) Avail: NTIS HC \$4.50 CSCL 02C

**N76-20600\*#** National Marine Fisheries Service, Bay Saint Louis, Miss. Technology Div.

**LANDSAT MENHADEN AND THREAD HERRING RESOURCES INVESTIGATION** Progress Report, 30 Jul. 31 Oct. 1975

Andrew J. Kemmerer, Principal Investigator Oct. 1975 48 p ERTS

(NASA Order S-54114)

(E76-10253; NASA-CR-146625; SEFC-Contrib-434;

MARMAP-Contrib-106) Avail: NTIS HC \$4.00 CSCL 08A

The author has identified the following significant results. The most significant achievement realized thus far has been the successful completion of the data acquisition phase. This success must be attributed to the interest, support, and competency of the participants. The apparent consistency of water color and turbidity condition, over time and between test sites at sites of menhaden capture is significant especially since color is readily measured with satellite and aircraft sensors and a LANDSAT MSS based computer model for inferring turbidity has been developed.

**N76-20601\*#** Agriculture Dept., Hyattsville, Md.

**GYPSY MOTH DEFOLIATION ASSESSMENT: FOREST DEFOLIATION IN DETECTABLE FROM SATELLITE IMAGERY** Final Report, 1973

Harry J. Moore, Principal Investigator and Wayne G. Rohde Sep. 1975 18 p refs Original contains imagery. Original photography

may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS (NASA Order S-70251-AG)

(E76-10254; NASA-CR-146626) Avail: NTIS HC \$3.50 CSCL 02F

The author has identified the following significant results. ERTS-1 imagery obtained over eastern Pennsylvania during July 1973, indicates that forest defoliation is detectable from satellite imagery and correlates well with aerial visual survey data. It now appears that two damage classes (heavy and moderate-light) and areas of no visible defoliation can be detected and mapped from properly prepared false composite imagery. In areas where maple is the dominant species or in areas of small woodlots interspersed with agricultural areas, detection and subsequent mapping is more difficult.

**N76-20611\*#** Scientific Translation Service, Santa Barbara, Calif.

**USE OF REMOTE SENSORS IN THE VERACRUZ FLORA PROGRAM**

M. Soto, A. Gomez-Pompa, F. Menendez, and G. Arp Washington NASA Apr. 1976 11 p Transl. into ENGLISH of "Uso de los Sensores Remotos en el Programa Flora de Veracruz" (unpublished report) Mexico City, Mexico Univ., 1976 8 p (Contract NASw-2791)

(NASA-TT-F-16943) Avail: NTIS HC \$3.50 CSCL 08F

Use of remote sensing in some of the investigations which are being carried out within the Veracruz Flora Program are presented. This includes digitalization of the climate map of the State of Veracruz for the purpose of obtaining automatic correlations between species, locality where it is found, and type of climate. Author

**N76-20613\*#** Agricultural Research Service, Phoenix, Ariz.

**SOIL WATER CONTENT AND EVAPORATION DETERMINED BY THERMAL PARAMETERS OBTAINED FROM GROUND-BASED AND REMOTE MEASUREMENTS** Final Report

R. Reginato, S. Idso, J. Vedder, R. Jackson, M. Blanchard, and R. Goettelman [1975] 44 p refs Repr. from Sci., v. 189, 19 Sep. 1975 p 991-992

(NASA Order S-53769-A)

(NASA-CR-144733; RFP5-39531-255) Avail: NTIS HC \$4.00 CSCL 08L

A procedure is presented for calculating 24-hour totals of evaporation from wet and drying soils. Its application requires a knowledge of the daily solar radiation, the maximum and minimum, air temperatures, moist surface albedo, and maximum and minimum surface temperatures. Tests of the technique on a bare field of Avondale loam at Phoenix, Arizona showed it to be independent of season. Author

**N76-21632\*#** Pacific Southwest Forest and Range Experiment Station, Berkeley, Calif.

**EXTENSIVE INVENTORY OF FOREST RESOURCES BY MULTISTAGE SAMPLING** Progress Report, 7 Dec. 1975 - 7 Mar. 1976

Robert C. Aldrich, Robert W. Dana, and Edwin H. Roberts, Principal Investigators 19 Mar. 1976 6 p ERTS

(NASA Order S-54053-A)

(E76-10265; NASA-CR-146566; PR-4) Avail: NTIS HC \$3.50 CSCL 02F

**N76-21634\*#** Kansas Univ. Center for Research, Inc., Lawrence. Remote Sensing Lab.

**CROP IDENTIFICATION FROM RADAR IMAGERY OF THE HUNTINGTON COUNTY, INDIANA TEST SITE**

P. P. Bativala and F. T. Ulaby, Principal Investigators Nov. 1975 25 p refs EREP

(Contract NAS9-10261)

(E76-10267; NASA-CR-147516; RSL-TR-177-58) Avail: NTIS HC \$3.50 CSCL 02B

The author has identified the following significant results. Like polarization was successful in discriminating corn and

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soybeans; however, pasture and woods were consistently confused as soybeans and corn, respectively. The probability of correct classification was about 65%. The cross polarization component (highest for woods and lowest for pasture) helped in separating the woods from corn, and pasture from soybeans, and when used with the like polarization component, the probability of correct classification increased to 74%.

**N76-21635\*** Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.

### RESULTS FROM THE CROP IDENTIFICATION TECHNOLOGY ASSESSMENT FOR REMOTE SENSING (CITARS) PROJECT

M. E. Bauer, Principal Investigator, B. J. Davis, R. M. Bizzell (NASA, Johnson Space Center), F. G. Hall (NASA, Johnson Space Center), A. H. Feiveson (NASA, Johnson Space Center), W. A. Malila (Environmental Res. Inst. of Michigan, Ann Arbor) (Environmental Res. Inst. of Michigan, Ann Arbor), and D. P. Rice 1976 40 p refs Presented at Proc. of the 10th Intern. Symp. on Remote Sensing of Environment, Ann Arbor, Mich., 6-10 Oct. 1975 Original contains imagery. Original Photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 EREP (Contract NAS9-14016) (E76-10268; NASA-CR-147518; LARS-Info-Note-012176) Avail: NTIS HC \$4.00 CSCL 02B

The author has identified the following significant results. It was found that several factors had a significant effect on crop identification performance: (1) crop maturity and site characteristics, (2) which of several different single date automatic data processing procedures was used for local recognition, (3) nonlocal recognition, both with and without preprocessing for the extension of recognition signatures, and (4) use of multirate data. It also was found that classification accuracy for field center pixels was not a reliable indicator of proportion estimation performance for whole areas, that bias was present in proportion estimates, and that training data and procedures strongly influenced crop identification performance.

**N76-21638\*** Kansas Univ. Center for Research, Inc., Lawrence. Remote Sensing Lab.

### CORN GROWTH AS MONITORED BY RADAR

Fawwaz T. Ulaby and Thomas F. Bush, Principal Investigators Nov. 1975 134 p refs EREP (Contract NAS9-10261) (E76-10271; NASA-CR-147515; RSL-TR-177-57) Avail: NTIS HC \$6.00 CSCL 02C

The author has identified the following significant results. At angles of incidence of 40 deg or greater, the results of the data analysis indicate a strong correlation between the radar backscattering coefficient and the normalized plant water content  $w(pn)$ , where  $w(pn)$  is the mass of water in the corn plant divided by its height. The correlation coefficient between the backscattering coefficient and  $w(pn)$ , which was calculated for each of 176 different combinations of the radar parameters (signal frequency, angle of incidence, and polarization) was highest (0.96) at 17.0 GHz, 50 deg and VV polarization. Considering the fact that the data used covered a period of four months during which the corn plants underwent considerable change in geometry and dielectric properties, the high correlation of 0.96 between backscattering coefficient and  $w(pn)$  points to a promising future for radar as a tool for monitoring corn development.

**N76-21639\*** Colorado State Univ., Fort Collins. Dept. of Earth Resources.

### SIGNATURE EXTENSION FOR SUN ANGLE, VOLUME 1 Final Report, 15 Nov. 1974 - 14 Nov. 1975

J. A. Smith, Principal Investigator, J. K. Berry, and F. Heimes Nov. 1975 111 p refs EREP (Contract NAS9-14467) (E76-10272; NASA-CR-147464) Avail: NTIS HC \$5.00 CSCL 03B

The author has identified the following significant results. Within a restricted zenith sun angle range of 35 - 50 degrees, it was empirically observed that canopy reflectance is mainly Lambertian. Reflectance changes with crop stage were simple

shifts in scale in the sun angle range. It was noted that sun angle variations depend on canopy characteristics. Effects of the vegetative canopy were most pronounced at the larger solar zenith angles (20 %). The linear sun angle correction coefficients demonstrate a dependency on both crop stage (15-20 %) and crop type (10-20 %). The use of canopy reflectance modeling allowed for the generation of a simulated data set over an extremely broad envelope of sun angles.

**N76-21642\*** Coffee Institute, Rio de Janeiro (Brazil).

### COFFEE INVENTORY THROUGH ORBITAL IMAGERY

Marcos Henrique Velloso, Principal Investigator, Antonieta Parda CoutinhodeMoraes, Dyckson DiasdeSouza, Hector McNeill, Jose Maria Assumpcao, and Shoji Iwamoto Dec. 1974 19 p Sponsored by NASA Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS (E76-10275; NASA-CR-146646; Rept-1) Avail: NTIS HC \$3.50 CSCL 02C

**N76-21649\*** Maden Tetkik ve Arma Enstitusu, Ankara (Turkey).

### NATIONAL PROJECT FOR THE EVALUATION OF ERTS IMAGERY APPLICATIONS TO VARIOUS EARTH RESOURCES PROBLEMS OF TURKEY Progress Report, 1 Oct. - 31 Dec. 1975

Sadrettin Alpan, Principal Investigator 31 Dec. 1975 12 p Sponsored by NASA ERTS (E76-10282; NASA-CR-146652; PR-1) Avail: NTIS HC \$3.50 CSCL 08F

**N76-21653\*** Environmental Research Inst. of Michigan, Ann Arbor.

### UTILIZATION OF SKYLAB (EREP) SYSTEM FOR APPRAISING CHANGES IN CONTINENTAL MIGRATORY BIRD HABITAT Final Report, May 1973 - Dec. 1975

David S. Gilmer, Principal Investigator (Northern Prairie Wildlife Research Center, Jamestown, N. D.) and Edgar A. Work, Jr. Dec. 1975 119 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 EREP (NASA Order T-4114-B; Contract DI-14-16-0008-802) (E76-10286; NASA-CR-147542; ERIM-105500-57-F) Avail: NTIS HC \$5.50 CSCL 06C

**N76-21658\*** Pennsylvania Univ., Philadelphia.

### DETECTION OF CROP MARK CONTRAST FOR ARCHAEOLOGICAL SURVEYS Final Report, Jan. - Sep. 1975

Froelich G. Rainey, Principal Investigator, John N. Hampton (Roy. Commission on Historical Monuments, London), and Bruce W. Bevan Apr. 1976 24 p refs Sponsored in part by NSF Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS (Contract NAS5-20792) (E76-10291; NASA-CR-146783) Avail: NTIS HC \$3.50 CSCL 02C

**N76-21660\*** California Univ., Berkeley. Space Sciences Lab.

### APPLICATION OF PHOTINTERPRETATIVE TECHNIQUES TO WHEAT IDENTIFICATION, SIGNATURE EXTENSION, AND SAMPLING STRATEGY Quarterly Progress Report, 16 Nov. 1975 - 15 Feb. 1976

R. N. Colwell, Principal Investigator, C. M. Hay, and R. W. Thomas 19 Mar. 1976 8 p EREP (Contract NAS9-14565) (E76-10293; NASA-CR-147526; SSL-Ser-17-Issue-21) Avail: NTIS HC \$3.50 CSCL 02C

**N76-21661\*** Purdue Univ., Lafayette, Ind.

### CROP IDENTIFICATION AND ACREAGE ESTIMATION

**OVER LARGE GEOGRAPHIC AREAS USING LANDSAT MSS DATA** Quarterly Progress Report, 1 Jan. - 31 Mar. 1976  
Marvin E. Bauer, Principal Investigator 31 Mar. 1976 4 p  
ERTS

(Contract NAS5-20793)

(E76-10294; NASA-CR-146784) Avail: NTIS HC \$3.50 CSCL 02C

The author has identified the following significant results. The comparison between the acreage estimates for the April LANDSAT data and the USDA Statistical Reporting Service estimates show no significant difference for the south central crop reporting district in Kansas. A paired-t test with an  $\alpha = .05$  was run comparing the percentages of wheat in each county. The results of their test showed no significant difference between the two estimates for wheat.

**N76-21669#** Minnesota Univ., St. Paul. Water Resources Research Center.

**A HYDRONOMIC ANALYSIS OF FOREST MANAGEMENT ALTERNATIVES FOR ENVIRONMENTAL QUALITY: A CASE STUDY OF ITASCA COUNTY**

Arthur P. OHayre, John C. Clausen, and Arnett C. Mace, Jr. Aug. 1975 134 p refs

(PB-248046/5; WRC-Bull-83; W76-02362;

OWRT-B-053-MINN-1) Avail: NTIS HC \$6.00 CSCL 02F

The input-output technique was the general methodology used for integrating water use. Direct and direct-plus-indirect water use coefficients (total withdrawn and consumptive) were determined for each of the 34 economic sectors in Itasca County, Minnesota. An example was developed that compared the water yield from the harvesting alternatives of clearcutting, strip cuts, and selection cuts. A zero water use coefficient was used for timber production, under water surplus conditions, and the water required was 44 million gallons. GRA

**N76-21672#** Kansas State Highway Commission, Topeka. Remote Sensing Section.

**SOIL IDENTIFICATION BY REMOTE SENSING TECHNIQUES IN KANSAS, PART 2 Final Report**

L. D. Myers and A. H. Stallard Jul. 1975 32 p

(PB-248219/8; FHWA-RD-75-129-Pt-2) Avail: NTIS HC \$4.00 CSCL 08B

The purpose is to evaluate various types of remote sensing data when used to delineate and map engineering soil conditions that are significant in highway engineering. Three study areas provided a broad spectrum of soils and geologic conditions encountered in eastern Kansas. Delineation of these soil types and conditions is feasible with color aerial photography and appropriate ground reconnaissance. In addition, general information pertaining to depth to bedrock and the ground water table can be extracted from aerial photography; however, more detailed information of this type, that might be obtained on infrared imagery, would be invaluable. GRA

## 02

### ENVIRONMENTAL CHANGES AND CULTURAL RESOURCES

Includes land use analysis, urban and metropolitan studies, environmental impact, air and water pollution, geographic information systems, and geographic analysis.

**A76-18921** Environmental monitoring from spacecraft data. R. H. Rogers, C. L. Wilson, L. E. Reed, N. J. Shah, R. Akeley (Bendix Corp., Aerospace Systems Div., Ann Arbor, Mich.), T. G. Mara (Ohio-Kentucky-Indiana Regional Council of Governments, Cincinnati, Ohio), and V. E. Smith (Cranbrook Institute of Science, Bloomfield Hills, Mich.). In: Symposium on Machine Processing of Remotely Sensed Data, 2nd, West Lafayette, Ind., June 3-5, 1975, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 38-11 to 38-20. 8 refs.

The Ohio-Kentucky-Indiana Regional Council of Governments is developing a deterministic model for predicting water quality, i.e., sediment and nutrient flow into the waterways of its region. Essential to the model is an accurate land use map for the watersheds. This information was obtained through the computer processing of Landsat-1 digital tapes. The computer tabulations covered 16 land use categories within 225 drainage areas. The 16 categories were merged into 10 categories and mapped at a scale of 1 inch equals 5,000 feet with detail to 1.1 acre for the 2,700 square mile region. B.J.

**A76-18926** Use of topographic data on land-use land-cover delineation by ERTS imagery. S. I. Solomon, J. Cameron, J. Chadwick (Waterloo, University, Waterloo, Ontario, Canada), and A. S. Aggarwal (Environment Canada, Ottawa, Canada). In: Symposium on Machine Processing of Remotely Sensed Data, 2nd, West Lafayette, Ind., June 3-5, 1975, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 48-1, 48-2.

The United States and Canada have undertaken a cooperative venture to estimate hydrological land-use, land-cover data from Landsat imagery at a high level of accuracy. A significant portion of the errors in estimating this Landsat data by means of clustering and pattern recognition is related to 'noise' in the data, i.e., variations of spectral signature of land-use, land-cover around various topographic and atmospheric factors. Research undertaken by the Water Planning and Management Branch of the Department of the Environment attempts to study the effects of topography (elevation, slope, and slope orientation) in producing this noise, and to reduce this noise by transforming conventional topographic data into data corresponding to pixels. B.J.

**A76-19335** Indirect sounding of the atmosphere from NOAA spacecraft - Regression after categorization method and results. A. Werbowetzki (NOAA, National Environmental Satellite Service, Washington, D.C.). In: Conference on Probability and Statistics in Atmospheric Sciences, 4th, Tallahassee, Fla., November 18-21, 1975, Preprints. Boston, American Meteorological Society, 1975, p. 165-170. 11 refs.

A regression method to analyze real-time temperature and optical thickness profiles from Vertical Temperature Profile Radiometer measurements made from NOAA satellites is described. A dependent sample is sorted into three categories based on the clear radiance value of the window channel. A stepwise regression was performed on each category for eight steps. Regression coefficients were selected on the basis of minimizing the standard error of estimate after correction for degrees of freedom. Tables are presented listing results of radiometer observations and comparing

them with radiosonde data for the period January through July 1975. B.J.

**A76-19839 \*** Satellite measurements of high-altitude twilight Mg(plus) emission. J.-C. Gérard (Liège, Université, Ougrée, Belgium). *Journal of Geophysical Research*, vol. 81, Jan. 1, 1976, p. 83-87. 27 refs. Grant No. NGR-06-003-127.

Observations made by the ultraviolet spectrometer on board the orbiting geophysical observatory OGO 4 confirmed the presence of resonance scattering at 2800 Å of Mg(plus) ions in the twilight subtropical ionosphere. The column density reached 4 billion ions/sq cm above 160 km. Photometric measurements by the ESRO TD 1 satellite revealed a maximum of the Mg(plus) abundance at equinoxes in the top side F region. The interhemisphere asymmetries observed in the intensity distribution are essentially attributed to the effect of eastward thermospheric winds. The 2800-Å doublet was also detected by OGO 4 at middle and high latitudes from 110 to 250 km. The brightness of the emission and other evidence indicate that evaporation of meteoritic matter cannot explain the abundance of ions at 200 km. Therefore Mg(plus) ions are probably transported upward from the 100-km permanent source layer. (Author)

**A76-19860 \*** Repeated sharp flux dropouts observed at 6.6 earth radii during a geomagnetic storm. S.-Y. Su (Lockheed Electronics Co., Inc., Planetary and Earth Sciences Dept., Houston, Tex.), T. A. Fritz (NOAA, Space Environment Laboratory, Boulder, Colo.), and A. Konradi (NASA, Johnson Space Center, Houston, Tex.). *Journal of Geophysical Research*, vol. 81, Jan. 1, 1976, p. 245-252. 12 refs.

A number of repeated rapid flux dropouts have been observed at 6.6 earth radii by the low-energy proton detectors on board the ATS 6 satellite during the July 4-6, 1974, geomagnetic storm period. These rapid flux changes are caused by the fact that the outer boundary of the trapped radiation region moves back and forth past the satellite. Although a tilting field line configuration can cause the boundary to pass the satellite, as has frequently been reported in the literature, the boundary is shown to be distorted by a large surface wave traveling eastward around the earth. The maximum velocity of the wave was observed to be about 40 km/s. (Author)

**A76-19965** The relation of a mid-latitude 6300 Å arc to substorm associated phenomena. J. S. Prasad, T. E. Old, and J. S. Kim (New York, State University, Albany, N.Y.). *Annales de Géophysique*, vol. 31, July-Sept. 1975, p. 361-367. 16 refs. NSF Grant No. GA-25262.

The mid-latitude 6300 Å (OI) arc of May 28/29, 1970 was studied with respect to variations in the geomagnetic fields. This arc was unusual in the fact that it was observed during a period when two distinct consecutive magnetic substorms occurred. At the times of the substorms, there was a strong variation in position of the arc from its general trend of the southward motion. Also, it was seen that the intensity of the arc increased during the times of the substorms. These observations were studied in terms of equivalent current systems of the substorms. It was found that the growth and decay of the concurrent magnetic substorms were strongly associated with convective DP2-like current systems. It was also found that the variations in the position and intensity of the arc were likewise strongly related to the DP2-like current systems. (Author)

**A76-19970** Geomagnetic stormtime variation of electron content in equatorial anomaly region. N. D. Kaushika and K. S. V. Madan (Delhi, University, Delhi, India). *Annales de Géophysique*, vol. 31, July-Sept. 1975, p. 401-404. 17 refs.

The continuous records of ionospheric electron content made at S. J. Campos in Brazil are analyzed to investigate the geomagnetic stormtime variations in the equatorial anomaly region. The geomagnetic storms influence the daytime and nighttime electron

## 02 ENVIRONMENTAL CHANGES AND CULTURAL RESOURCES

content in entirely different ways. It is seen that on geomagnetic storm days the average level of the daytime maximum in the electron content curve is considerably low compared to the quiet days. This is due to the well documented stormtime depletion of equatorial anomaly. The geomagnetic stormtime variations of the nighttime electron content are rather anomalous. A spatial resonance mechanism in the F-layer caused by the interaction of atmospheric gravity waves with the ionospheric plasma drifts (or electric fields) of equatorial zone, appears suitable to explain these variations.

(Author)

**A76-20213 # Further use of natural infrasound as a continuous monitor of the upper atmosphere.** D. Rind (Lamont-Doherty Geological Observatory, Palisades, N.Y.) and W. L. Donn (Lamont-Doherty Geological Observatory, Palisades; City College, New York, N.Y.). *Journal of the Atmospheric Sciences*, vol. 32, Sept. 1975, p. 1694-1704. 158 refs. NSF Grant No. GA-42975X; Grant No. DAHC04-74-G-0172.

Infrasound generated by ocean waves and reflected from the lower thermosphere via combined wind and temperature effects is picked up by capacitor microphone arrays and examined to yield information on tidal circulation and wind and temperature patterns in the lower thermosphere. When the height of the tidal circulation is determined, infrasound/microseism ratios can be calibrated against that height. Semidiurnal and diurnal oscillations in tidal wind variation during the winter are examined by the technique. Advantages of infrasound monitoring of upper atmosphere tides include low cost, continuous availability, and adaptability to on-line data processing.

**A76-20237 # Measurement of the components of the geomagnetic field by a minimum-value method (Izmerenie sostavlyayushchikh magnitnogo polia zemli metodom minimuma).** O. K. Shoniia (Akademii Nauk Gruzinskoi SSR, Institut Geofiziki, Tiflis, Georgian SSR). *Akademii Nauk Gruzinskoi SSR, Soobshcheniia*, vol. 80, Oct. 1975, p. 97-100. In Russian.

The theoretical basis of a minimum-value method for measuring the magnitude of the geomagnetic field from a given vector with a known modulus is outlined. The numerical measurement of the geomagnetic field by the minimum-value method is performed by a modulus-measuring device represented by a quantum T-magnetometer provided with a compensating element in the form of a winding. The necessary magnitude of the compensating field is chosen according to the readings of the T-magnetometer indicator. The minimum-value reading on the five-digit digital indicator represent the magnitude of the geomagnetic field to be determined. The resulting measurement error lies within  $\pm 3$  gammas. S.D.

**A76-20330 # Pollution monitoring systems based on resonance absorption measurements of ozone with a 'tunable' CO<sub>2</sub> laser - Some criteria.** J. Shewchun, B. K. Garside, E. A. Ballik, C. C. Y. Kwan, M. M. Elsherbiny, G. Hogenkamp, and A. Kazandjian (McMaster University, Hamilton, Ontario, Canada). *Applied Optics*, vol. 15, Feb. 1976, p. 340-346. 18 refs. Research supported by the Department of Health and Welfare, Ministry of the Environment of Ontario and Atmospheric Environment Service, Environment Canada.

Measurements have been made with a line tunable CO<sub>2</sub> laser on ozone in order to establish some useful criteria for pollution monitoring via the direct absorption scheme. The absorption coefficient and the pressure dependence of the extinction coefficient at frequencies corresponding to the P(8) to P(36) vibration-rotation lines of the CO<sub>2</sub> laser have been measured. Good agreement has been found with theory (within the framework of Lorentz and Doppler broadenings) for these experimental observations. It has been found that foreign gas species lines within plus or minus 0.1 per cm of the laser line can contribute significantly to the absorption process if their absorption intensities are not more than an order of magnitude below the intensity of the gas species being monitored. (Author)

**A76-20592 # Refractive effects in remote sensing of the atmosphere with infrared transmission spectroscopy.** D. E. Snider (U.S. Army, Ballistics Research Laboratories, Aberdeen Proving Ground, Md.). *Journal of the Atmospheric Sciences*, vol. 32, Nov. 1975, p. 2178-2184. 26 refs.

A ray-tracing technique is used to study the effects of atmospheric refraction on the computed air mass and the single layer effective pressure for a grazing ray from the sun. Results indicate that neglecting refraction in the computation of air mass and effective pressure can lead to overestimates of these quantities by up to 25% for aircraft observers, 60% for high altitude balloons, and 200% for satellite observers. (Author)

**A76-20998 \* ERTS-1 data applied to strip mining.** A. T. Anderson and J. Schubert (NASA, Goddard Space Flight Center, Greenbelt, Md.). *Photogrammetric Engineering and Remote Sensing*, vol. 42, Feb. 1976, p. 211-219. 6 refs.

Two coal basins within the western region of the Potomac River Basin contain the largest strip-mining operations in western Maryland and West Virginia. The disturbed strip-mine areas were delineated along with the surrounding geological and vegetation features by using ERTS-1 data in both analog and digital form. The two digital systems employed were (1) the ERTS analysis system, a point-by-point digital analysis of spectral signatures based on known spectral values and (2) the LARS automatic data processing system. These two systems aided in efforts to determine the extent and state of strip mining in this region. Aircraft data, ground-verification information, and geological field studies also aided in the application of ERTS-1 imagery to perform an integrated analysis that assessed the adverse effects of strip mining. The results indicated that ERTS can both monitor and map the extent of strip mining to determine immediately the acreage affected and to indicate where future reclamation and revegetation may be necessary. (Author)

**A76-21181 Meteorological surveillance of the North Atlantic by satellite (La surveillance météorologique de l'Atlantique Nord par satellite).** L. Le Ninivin (Météorologie Nationale, Paris, France). *La Météorologie*, Nov. 1975, p. 61-70. In French.

Cloud data obtained by meteorological satellites is analyzed to facilitate air navigation over the North Atlantic. The nephanalysis covers the following meteorological features: the spiral cyclonic cloud structure called VORTEX, the frontal cloud masses associated with this structure, zones of convection cloud masses, cloud structures caused by the jet streams, the intertropical convergence of convection clouds, and desert sands blown into the upper troposphere. The analysis shows that there are significant correlations between the cloud structures and temperature fields at the stage of cloud formation, with the vortex center coinciding with a minimum temperature. B.J.

**A76-21930 # Laser beam - Atmospheric aerosol interactions.** G. E. Caledonia and J. D. Teare (Physical Sciences, Inc., Wakefield, Mass.). *American Society of Mechanical Engineers, Winter Annual Meeting, Houston, Tex., Nov. 30-Dec. 4, 1975, Paper 75-WA/HT-42*. 11 p. 22 refs. Members, \$1.50; nonmembers, \$3.00. Contract No. N00014-74-C-0295.

A model for the prediction of the temperature and vapor fields created about a small water droplet undergoing irradiation by a laser beam has been developed. Time dependent and steady state solutions of the model are discussed, as well as the possible effects of a number of aerosol properties not included in the model. Estimates of characteristic phase shifts to be expected in propagating through standard atmospheric aerosol distributions are also presented. While the model is quite general, the calculations are limited to DF laser wavelengths. (Author)

**A76-23576 Ozone Seminar, 4th, Belsk, Poland, July 8, 1974, Proceedings (Seminarium Ozonu, 4th, Belsk, Poland, July 8,**

1974, Proceedings). Seminar sponsored by the Polska Akademia Nauk. *Polska Akademia Nauk, Instytut Geofizyki, Materiały i Prace*, vol. 90, 1975. 132 p. In Polish, English, and German.

The papers collected in this volume deal with descriptions of ozonometric instruments and the analysis of results of ozone measurements taken over the course of many years, at all times of the year, at many different locations, and under all meteorological conditions. Some of the topics covered include a short-wave spectrophotometer for field measurements, an ozonometer with narrow-band interference light filters, comparison of the M-83 ozonometer with the Dobson spectrophotometer, changes of total ozone content observed prior to midwinter stratospheric warmings, and the upper ozonosphere redistribution during solar eclipses and flares.

P.T.H.

**A76-23578 #** New multiwave method and instrument for observation of atmospheric ozone and aerosol. G. I. Kuznetsov (Moskovskii Gosudarstvennyi Universitet, Moscow, USSR). (*Polska Akademia Nauk, Seminarium Ozonu, 4th, Belsk, Poland, July 8, 1974.*) *Polska Akademia Nauk, Instytut Geofizyki, Materiały i Prace*, vol. 90, 1975, p. 13-20. 6 refs.

Description of an instrument for recording the spectrum of direct and scattered solar radiation in the wavelength range 3000-8000 Å employing a double quartz monochromator is given. A logarithmic amplifier and special multialkaline photomultiplier remove the difficulty associated with the different intensity (by four orders of magnitude) at the opposite ends of the range scanned. Spectral sensitivity of the photomultiplier is maximum at 2900 Å, falls to 1% of this maximum at 3500 Å, and remains at this level for the rest of the spectrum. Also, a new multiwave method for atmospheric ozone measurements using nine wavelengths and accounting for aerosol errors is described.

P.T.H.

**A76-23579 #** Investigation of the atmospheric ozone by means of ozonometer with narrow-band interference light filters. A. L. Osherovich, L. G. Bol'shakova, N. S. Shpakov, and V. T. Zarubylo (Leningradskii Gosudarstvennyi Universitet, Leningrad, USSR). (*Polska Akademia Nauk, Seminarium Ozonu, 4th, Belsk, Poland, July 8, 1974.*) *Polska Akademia Nauk, Instytut Geofizyki, Materiały i Prace*, vol. 90, 1975, p. 21-30. 12 refs.

The paper describes design and operation of an ozonometer employing photoelectric interference filters with spectral range in the Hartley band 18-20 Å. Transmission beyond the working range of the filters does not exceed 0.0001-0.000001 of the transmission at maximum, which provides for high sensitivity to ozone content variation. Dynamic range is 10 to the ninth power, permitting ozone observations from measurements of solar, lunar, and zenith radiation without changing apparatus parameters. Formulas are presented for calculating ozone content with appropriate expressions for the mean coefficients of ozone absorption, molecular absorption, and aerosol absorption. Lack of sufficient knowledge of spectral properties of aerosols means that filter measurements of ozone can not be carried out with accuracy better than 5-10%.

P.T.H.

**A76-23580 #** Comparison of parallel ozone measurements in Budapest. E. Borbely (Central Institute of Atmospheric Physics, Budapest, Hungary). (*Polska Akademia Nauk, Seminarium Ozonu, 4th, Belsk, Poland, July 8, 1974.*) *Polska Akademia Nauk, Instytut Geofizyki, Materiały i Prace*, vol. 90, 1975, p. 31-39.

The paper presents the results of a comparison between simultaneous measurements of ozone content in the atmosphere carried out by two different types of ozonometer: a Dobson spectrophotometer and an M-83 universal ozonometer. The results of the two devices deviate quite strongly. The correlation coefficient between the two series of measurements and the linear regression coefficients between the difference between the two ozone values and the mu-parameter and the turbidity factor were computed. The correlation was positive. The main reason for the deviation between the two instruments is the fact that the universal ozonometer, being a filter instrument, transmits radiation in a wider spectral range than the Dobson instrument, so that effects such as air pollution,

absorption of different gases in the atmosphere, and scattering of air molecules have more weight on the M-83 measurements. P.T.H.

**A76-23588 #** The international comparison of ozone spectrophotometers at Belsk, 24 June-6 July 1974. A. Dziewulska-Losiowa and C. D. Walshaw. *Polska Akademia Nauk, Instytut Geofizyki, Materiały i Prace*, vol. 89, 1975, p. 3-19. 21-59.

The work summarizes the main results of an international workshop in which scientists from twelve countries brought to a single site (Belsk, Poland) the ozone spectrophotometers with which they had been working in their own countries, in an effort (1) to determine whether the instruments and their operation were understood fully, (2) to determine whether the instruments are adjusted and working properly, and (3) to carry out simultaneous observations with all the instruments so that the relationships between the readings they provide could be established. Such a workshop was deemed necessary if the world network of ozone spectrophotometers is to provide reliable and comparable data from all its sites. Nine Hobson spectrophotometers and three filter ozonometers took part in the tests. Intercomparison of readings was carried out in both direct-sun and zenith sky observations. Conclusions are drawn regarding the worthiness of the various instruments, and vast amounts of correlational data are tabularized.

P.T.H.

**A76-23805** Remote sensing of atmospheric water content from satellites using microwave radiometry. N. C. Grody (NOAA, National Environmental Satellite Service, Washington, D.C.). *IEEE Transactions on Antennas and Propagation*, vol. AP-24, Mar. 1976, p. 155-162. 25 refs.

Analysis is presented which substantiates the high correlation achieved in relating integrated water vapor and liquid water to brightness temperatures at frequencies near the 22.235 GHz water vapor line. The influence of atmospheric and surface variability is shown to be minimal over low emissivity sea surfaces. Determination of atmospheric water content using regression techniques is shown to follow directly from radiation transfer theory. Satellite data from the Nimbus-E Microwave Spectrometer (NEMS) aboard Nimbus-5 are compared with radiosonde water vapor measurements and cloud images recorded by the temperature humidity infrared radiometer aboard Nimbus 5.

(Author)

**A76-24747 #** Radiation balance of the ocean-atmosphere system and its components from calculated data and satellite measurements (Radiatsionnyi balans sistemy okean-atmosfera i ego sostavliaushchie po dannym raschetov i sputnikovyx izmereniy). N. A. Timofeev (Akademiia Nauk Ukrainskoi SSR, Morskoi Gidrogizicheskii Institut, Moscow, USSR). *Akademiia Nauk SSSR, Izvestiia, Fizika Atmosfery i Okeana*, vol. 11, Dec. 1975, p. 1330-1333. 7 refs. In Russian.

**A76-24816 #** Stratospheric aerosol size distribution. O. Uchino and M. Hirono (Kyushu University, Fukuoka, Japan). *Journal of Geomagnetism and Geoelectricity*, vol. 27, no. 3, 1975, p. 201-215. 22 refs.

Typical stratospheric aerosol size distributions so far proposed are examined on the basis of data on lidar backscattering and on small ion density. It is shown that power law distribution can account for both lidar backscattering coefficient and small ion density if Aitken particles are taken into account. Bimodal size distribution is the result of both sulfuric acid nucleation and increased outer particle injection such as meteor particles or volcanic eruption. Aerosol size distribution is calculated for meteor particles undergoing sedimentation, eddy diffusion, and growth by attachment of tiny sulfuric acid particles under the assumption of power law size distribution. Meteor particle size distribution is found to be lognormal. Bimodal size distribution is formed both by the lognormal size distribution and the preexisting Aitken size sulfuric acid particles.

S.D.



## 02 ENVIRONMENTAL CHANGES AND CULTURAL RESOURCES

**A76-24827** On the resolution of temperature profile fine-structure by the NOAA satellite vertical temperature profile radiometer. O. E. Thompson, J. K. Eom\* (Maryland, University, College Park, Md.), and J. R. Wagenhofer (USAF, Environmental Technical Applications Center, Scott AFB, Ill.). *Monthly Weather Review*, vol. 104, Feb. 1976, p. 117-126. 15 refs. NSF Grant No. P4-A0144-000.

**A76-25002** Influence of the atmosphere on the spectral brightnesses and contrasts of natural formations in spectrophotometry of the earth from space. K. Ia. Kondrat'ev, A. A. Buznikov, O. B. Vasil'ev, and O. I. Smoktii (Leningradskii Gosudarstvennyi Universitet; Leningradskii Gidrometeorologicheskii Institut, Leningrad, USSR). (*Akademiia Nauk SSSR, Izvestiia, Fizika Atmosfery i Okeana*, vol. 11, Apr. 1975, p. 348-361.) *Academy of Sciences, USSR, Izvestiya, Atmospheric and Oceanic Physics*, vol. 11, Nov. 1975, p. 210-218. 21 refs. Translation.

The influence of the atmosphere on spectral brightnesses and contrasts of natural formations during spectrophotometric measurements of the earth from space in the visible spectral region is considered. The problem of theoretical and experimental determination of the atmospheric transfer function for the cases of practical interest is stated and solved. The technique for the determination of transfer functions and their components from the results of combined subsatellite experiments is discussed. A detailed comparison of the experimental data obtained on Soyuz-7 and Soyuz-9 spacecrafts and of the corresponding theoretical calculations is made. Considerable influence of the nonuniformity of the underlying surface near the boundary of two media (sand and sea; sand-cloudiness) on the transformation of brightnesses and contrasts to the level of the upper atmospheric boundary is shown. (Author)

**A76-25239** # Status of sodar observation in Japan. M. Fukushima. (*International Union of Radio Science, General Assembly, 18th, Scientific Session on Theory and Results of Studies of the Lower Atmosphere by Acoustic Methods*, Lima, Peru, Aug. 1975.) *Radio Research Laboratories, Journal*, vol. 22, no. 109, 1975, p. 151-164. 5 refs.

Long-term sodar observations were carried out by a monostatic system provided with a paraboloidal dish of 16 m diameter. The general characteristics of the lower troposphere were determined, showing that there are diurnal and seasonal variations of wavy layers and thermal plume activities at a height range 200-1000 m. The visualized temperature structure obtained by sodar observation revealed that small-scale ordered motions play an important part in the clear troposphere. Echo intensity corresponded to the structure constant, squared  $C(T)$ , which was found to gradually decrease with height. The characteristic feature of the maritime planetary boundary layer observed at Miyakojima Island was that thermal plume type sodar echoes appeared in nighttime during the period of GARP AMTEX-1975. A truck-mounted sodar is developed for Doppler wind measurements. Future plans include radiometeorological applications of sodar. S.D.

**A76-25433** Land-use mapping from Skylab S-190B photography. H. F. Lins, Jr. (U.S. Geological Survey, Reston, Va.). *Photogrammetric Engineering and Remote Sensing*, vol. 42, Mar. 1976, p. 301-303, 305-307. 9 refs.

This article reports on research designed to analyze the suitability of S-190B photography for land-use mapping. The research has been undertaken in an effort to analyze the reliability of such land-use data. A Level III land-use map of the city of Fairfax, Virginia, interpreted from a Skylab 3 S-190B 'natural' color photograph was compared with a land-use map of the same area interpreted from a Wild RC-10 color-infrared photograph taken from a NASA U-2. The latter land-use map was field checked and corrected so that the relative accuracy of the Skylab map could be measured by direct comparison. Using the quotient of the number of points found to be the same, divided by the number of points

examined, researchers found the Skylab map to have a relative accuracy of approximately 83 per cent. (Author)

**A76-25501** Expert Conference on Laser Spectroscopy of the Atmosphere, Rjukan, Norway, June 15-21, 1975, Proceedings. Conference supported by NATO and U.S. Army. Edited by P.-E. Nordal (Forsvarets Forskningsinstitut, Kjeller, Norway). *Optical and Quantum Electronics*, vol. 8, Mar. 1976, 113 p.

The optical measurement of atmospheric pollutants is considered along with the physical properties of the atmosphere in relation to laser probing, the atmospheric motions of different scales and their transport capacities, the molecular absorption of infrared laser radiation in the natural atmosphere, spectroscopic measurements of the stratosphere using tunable infrared lasers, and laser approaches for long-path monitoring by resonance absorption. Attention is also given to pattern recognition as a potential tool for data analysis in atmospheric laser spectroscopy, global and regional monitoring from airborne and satellite platforms, and the infrared spectral properties of atmospheric molecules.

G.R.

**A76-25502** Optical measurement of atmospheric pollutants - Accomplishments and problems. P. L. Hanst (U.S. Environmental Protection Agency, Environmental Science Research Laboratory, Research Triangle Park, N.C.). (*NATO, Expert Conference on Laser Spectroscopy of the Atmosphere, Rjukan, Norway, June 15-21, 1975*.) *Optical and Quantum Electronics*, vol. 8, Mar. 1976, p. 87-93. 12 refs.

Two applications of optical methods to the measurement of atmospheric pollutants are discussed. The combination of Fourier Transform Spectrometer and long path infrared absorption cell has been used to measure many compounds simultaneously in polluted air samples at Pasadena, California. The detection limit for most pollutants has been about 10 billionths atmospheres partial pressure. A 4 km cell is being developed for use in 1976 with the objective of further lowering the detection limit by a factor of ten. Nondispersive spectral correlation techniques are also being applied in the ambient air. In this case a selected pollutant is measured by passing the infrared radiation from a thermal source through a train of passive components, including the atmospheric sample cell and a gas-filled filter cell. These spectral correlation methods show great sensitivity and selectivity and have a promising future for further application. (Author)

**A76-25503** Physical properties of the atmosphere in relation to laser probing. S. F. Clifford (NOAA, Wave Propagation Laboratory, Boulder, Colo.). (*NATO, Expert Conference on Laser Spectroscopy of the Atmosphere, Rjukan, Norway, June 15-21, 1975*.) *Optical and Quantum Electronics*, vol. 8, Mar. 1976, p. 95-104. 11 refs.

Spatial and temporal variations of turbulent refractive index fluctuations are considered, taking into account a theoretical prediction of the behavior of velocity turbulence as a function of fluctuation-parameter relations. The production of scintillations by refractive turbulence is investigated and effects of multiple scattering on the production of scintillation are studied. Attention is also given to aspects of aperture averaging and the reduction of scintillation. G.R.

**A76-25507** Laser spectroscopic instrumentation and techniques - Long-path monitoring by resonance absorption. E. D. Hinkley (MIT, Lexington, Mass.). (*NATO, Expert Conference on Laser Spectroscopy of the Atmosphere, Rjukan, Norway, June 15-21, 1975*.) *Optical and Quantum Electronics*, vol. 8, Mar. 1976, p. 155-167. 12 refs. Research supported by the U.S. Environmental Protection Agency and NSF.

Tunable laser spectroscopy has necessitated the introduction of new measurement techniques, particularly with regard to the wavelength calibration. This paper highlights some of these require-

ments and surveys laser spectroscopic measurements which have already been performed in the infrared. The rather unique properties of tunable infrared lasers also make them useful for air pollution monitoring. In particular, several tunable laser techniques have been used for long-path monitoring of ambient gases in the atmosphere by resonance absorption. The results of these measurements and prospects for the future will be discussed. (Author)

**A76-25510** Stratospheric chemistry and measurement techniques. P. L. Hanst, J. A. Cooney, E. Hesstvedt, P. L. Kelley, J. K. Kennedy, J. E. Lovelock, C. K. N. Patel, and G. Wang. (NATO, Expert Conference on Laser Spectroscopy of the Atmosphere, Rjukan, Norway, June 15-21, 1975.) *Optical and Quantum Electronics*, vol. 8, Mar. 1976, p. 187-191. 19 refs.

The possibility of a disturbance of the stratosphere by man-made substances is considered, taking into account effects on the thickness or the position of the stratospheric ozone region. It is pointed out that recent developments related to spectroscopic measurements make a comprehensive investigation of the real stratosphere possible. The chemical species to be measured include nitrogenous compounds, halogenated compounds, methane, carbon oxide, carbon dioxide, and water vapor. Attention must also be given to electron and negative ion chemistry and stratospheric air measurements. Types of measurements and measurement techniques are discussed, taking into account optical methods and the gas chromatographic method. G.R.

**A76-25511** Infrared spectral properties of atmospheric molecules. R. A. Toth, R. L. Abrams, G. Birnbaum, S. T. Eng, R. A. McClatchey, P. E. Nordal, and S. O. Olsen. (NATO, Expert Conference on Laser Spectroscopy of the Atmosphere, Rjukan, Norway, June 15-21, 1975.) *Optical and Quantum Electronics*, vol. 8, Mar. 1976, p. 191-194. 7 refs.

Accurate data on the spectral characteristics of the various molecules found in the atmosphere are required for infrared analytical studies of atmospheric trace constituents and pollutants. Information is needed concerning the vibration-rotation line center frequencies, line strengths, and air-broadened line widths. The currently available information with respect to these parameters is considered, taking into account a compilation of data provided by McClatchey et al. (1973). Attention is also given to general questions concerning the determination of molecular parameters and aspects of instrumentation. G.R.

**A76-25512** Long-path monitoring of atmospheric pollutant gases. H. Tannenbaum, R. L. Byer, S. F. Clifford, K. S. Fu, E. D. Hinkley, T. Jaeger, A. G. Kjelaas, K. W. Nill, M. Slatkine, and A. Wood. (NATO, Expert Conference on Laser Spectroscopy of the Atmosphere, Rjukan, Norway, June 15-21, 1975.) *Optical and Quantum Electronics*, vol. 8, Mar. 1976, p. 194-196. 6 refs.

Methods for the identification of one or more gases in the presence of others are considered, taking into account the limitations of existing laser devices and approaches for overcoming these limitations. Limits in the case of conventional infrared systems are imposed by optical elements such as spectral filters. Techniques for reducing turbulence effects are considered, giving attention to large optical apertures, multiple wavelengths, and digital processing. Approaches for increasing effective path length are also discussed. G.R.

**A76-25876 \*** International Conference on Environmental Sensing and Assessment, Las Vegas, Nev., September 14-19, 1975, Proceedings. Volumes 1 & 2. Conference sponsored by the World Health Organization, U.S. Environmental Protection Agency, U.S. Department of Transportation, NASA, NOAA, AIAA, et al. New York, Institute of Electrical and Electronics Engineers, Inc., 1976. Vol. 1, 569 p.; vol. 2, 600 p. Price of two volumes, members, \$26; nonmembers, \$35.

The papers deal with the detection of hazardous environmental pollutants, the development of emission control plans, and the design of compliance monitoring systems. Topics include remote sensing techniques in environmental pollution monitoring, monitoring of atmospheric particulate matter, air pollution due to sulfur dioxide and other inorganic compounds, marine pollution, atmospheric aerosols, industrial pollution, and legal aspects of pollution monitoring. Other papers examine the toxic effects of heavy metals and halogenated hydrocarbons, pollution associated with waste-disposal processes, pesticide residues in soil and groundwater, evaluations of groundwater quality, and monitoring of nuclear wastes. The interaction of climate and pollution is also discussed along with global pollutant transport, environmental modeling, ambient environmental air quality, aircraft and ground-vehicle emissions, and pollution associated with energy extraction and utilization processes.

Individual items are announced in this issue. F.G.M.

**A76-25877** Flow of toxic metals in the environment. D. W. Jenkins (Pan American Health Organization, Mexico City, Mexico). In: International Conference on Environmental Sensing and Assessment, Las Vegas, Nev., September 14-19, 1975, Proceedings. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1976, p. 1-1-1 to 5-1-1. 22 refs.

Environmental flow of 12 toxic metals is outlined along with quantitation of sources, flow in the atmosphere, terrestrial ecosystems, freshwater, and the ocean. Emissions from man-induced and natural sources are compared. Biological accumulation and concentration data are presented, based on a world-wide literature survey. Enrichment and concentration factors, and development of biological monitoring systems are discussed. Historical-trend data on the metals is reviewed. (Author)

**A76-25878** Sampling and analysis of metals in air, water and waste products. J. J. Morgan (California Institute of Technology, Pasadena, Calif.). In: International Conference on Environmental Sensing and Assessment, Las Vegas, Nev., September 14-19, 1975, Proceedings. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1976, p. 1-2-1 to 9-1-2. 83 refs.

Monitoring, sampling, and analysis for different environmental compartments are discussed from the point of view of source-flow-receptor and chemical-element-balance concepts. Needs for vapor-particulate fractions in the atmosphere and for corresponding dissolved-particulate fractions in the hydrosphere are examined. The metals of interest in monitoring air and water are compared, and typical levels and ranges for metals are reviewed. Standard, tentative, and approved methods of analysis in the U.S. are summarized for both water and air. Effects of sampling, storage, processing, and preconcentration steps in overall analysis are discussed. Various procedures now in use for collection, preconcentration, and sample preparation are reviewed with relation to accuracy of methods. A range of analysis methods used in monitoring or of potential utility in monitoring is examined. (Author)

**A76-25881** Design of nationwide water-quality monitoring networks. R. J. Pickering and J. F. Ficke (U.S. Geological Survey, National Center, Reston, Va.). In: International Conference on Environmental Sensing and Assessment, Las Vegas, Nev., September 14-19, 1975, Proceedings. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1976, p. 1-3-3 to 4-3-3. 5 refs.

The paper discusses the organization and development of national networks for monitoring water quality. Some design and operational principles of water-quality monitoring networks are outlined, including differences between surface-water and ground-water networks, the geographical scales of organization, types of measurements to be made, and how results should be reported. The National Stream Quality Accounting Network (NASQAN) of the U.S. Geological Survey is cited as a specific example of such a network. F.G.M.

## 02 ENVIRONMENTAL CHANGES AND CULTURAL RESOURCES

**A76-25882** Network design considerations for the global environmental monitoring system /GEMS/ of the United Nations. R. Citron (Smithsonian Institution, Cambridge, Mass.). In: International Conference on Environmental Sensing and Assessment, Las Vegas, Nev., September 14-19, 1975, Proceedings. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1976, p. 1 3-6 to 6 3-6. 22 refs.

**A76-25899** The regional air monitoring system - St. Louis, Missouri, U.S.A. R. L. Myers (Rockwell Air Monitoring Center, St. Louis, Mo.) and J. A. Reagan (U.S. Environmental Protection Agency, St. Louis, Mo.). In: International Conference on Environmental Sensing and Assessment, Las Vegas, Nev., September 14-19, 1975, Proceedings. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1976, p. 1 8-6 to 9 8-6.

The Regional Air Monitoring System (RAMS) is the ground-based air-quality measurement network of RAPS, the Regional Air Pollution Study. This 25-station network is the most sophisticated air-monitoring system currently operational. The central purpose of RAPS is to produce for a single urban area enough information on all processes that determine the concentrations of air pollutants so that they can be described in a system of mathematical models. This objective leads directly to the requirement that there be generated an extensive base of air-quality measurements against which calculated values may be compared. The RAMS stations also serve as experimental facilities for other investigations. In the present paper, an extensive description of the network, analyzers, data acquisition, quality control, and operations is given. (Author)

**A76-25900** Legal requirements for monitoring ground-water quality. H. O. Banks (Harvey O. Banks, Consulting Engineer, Inc., Belmont, Calif.) and L. G. McMillion (U.S. Environmental Protective Agency, Las Vegas, Nev.). In: International Conference on Environmental Sensing and Assessment, Las Vegas, Nev., September 14-19, 1975, Proceedings. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1976, p. 1 9-1 to 4 9-1.

The purposes to be served by data obtained through a monitoring program for a groundwater system must be defined and the data needs must be carefully evaluated. A specific monitoring program must be designed and implemented for each groundwater system. The extent of the monitoring program required will depend on present quality problems; the sources and causes of pollution; its relative present and future significance; the types and importance of the use(s) of the groundwaters; the geologic, hydrologic and hydraulic complexity of the system; and the data already available. The dynamic nature of groundwater systems must be clearly recognized in designing and implementing monitoring programs. The need to develop the capability to predict potential quality problems in order to formulate preventative programs on a timely basis is important in evaluating data requirements. (Author)

**A76-25906** Application of remote monitoring techniques in air enforcement. C. B. Ludwig and M. Griggs (Science Applications, Inc., La Jolla, Calif.). In: International Conference on Environmental Sensing and Assessment, Las Vegas, Nev., September 14-19, 1975, Proceedings. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1976, p. 1 10-1 to 4 10-1. U.S. Environmental Protection Agency Contract No. 68-02-2137.

The paper evaluates the application of remote-monitoring techniques in the enforcement of air pollution regulations for stack emissions. A distinction is made between evidentiary monitoring and surveillance, the different monitoring modes are distinguished, and legal aspects of air enforcement monitoring are examined. It is noted that while courts have questioned some visual observations of noncompliance, evidence obtained through the application of remote instrumental techniques apparently can be introduced in the same way as evidence used in nonenvironmental cases, although the

accuracy of the remote instrument must be specified. Both active and passive remote-monitoring techniques are described along with their main characteristics; the advantages and disadvantages of remote sensors are discussed with respect to in-stack monitors. It is concluded that the most promising active laser systems for near-term operational use are pulsed systems involving differential absorption, lidar, and laser Doppler velocimeters, while the most promising passive systems include correlation instruments, vidicons, and aerial photography. F.G.M.

**A76-25907 \*** Laser Doppler systems in pollution monitoring. C. R. Miller, C. M. Sonnenschein (Raytheon Co., Sudbury, Mass.), W. F. Herget (U.S. Environmental Protection Agency, Research Triangle Park, N.C.), and R. M. Huffaker (NASA, Marshall Space Flight Center, Huntsville, Ala.). In: International Conference on Environmental Sensing and Assessment, Las Vegas, Nev., September 14-19, 1975, Proceedings. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1976, p. 1 10-2 to 5 10-2. 7 refs. Research supported by the U.S. Environmental Protection Agency and NASA.

The paper reports on a program undertaken to determine the feasibility of using a laser Doppler velocimeter (LDV) to measure smoke-stack gas exit velocity, particulate concentration, and mass flow. Measurements made with a CO<sub>2</sub> laser Doppler-radar system at a coal-burning power plant are compared with in-stack measurements made by a pitot tube. The operational principles of a LDV are briefly described along with the system employed in the present study. Data discussed include typical Doppler spectra from smoke-stack effluents at various laser elevation angles, the measured velocity profile across the stack exit, and the LDV-measured exit velocity as a function of the exit velocity measured by the in-stack instrument. The in-stack velocity is found to be about 14% higher than the LDV velocity, but this discrepancy is regarded as a systematic error. In general, linear relationships are observed between the laser data, the exit velocity, and the particulate concentration. It is concluded that an LDV has the capability of determining both the mass concentration and the mass flow from a power-plant smoke stack. F.G.M.

**A76-25910 \*** Remote sensing of atmospheric pollutant gases using an infrared heterodyne spectrometer. R. K. Seals, Jr. (NASA, Langley Research Center, Hampton, Va.) and B. J. Peyton (Cutler-Hammer, Inc., AIL Div., Melville, N.Y.). In: International Conference on Environmental Sensing and Assessment, Las Vegas, Nev., September 14-19, 1975, Proceedings. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1976, p. 1 10-5 to 7 10-5. 28 refs.

Remote sensing of the concentration and vertical distribution of atmospheric gases using an infrared heterodyne spectrometer (IHS) has been investigated, and a dual (C-13)(O-16)<sub>2</sub> laser multichannel IHS has been developed. Analyses of nadir thermal-radiance measurements from an aircraft at 10-km altitude and of solar absorption measurements from the ground indicate that initial applications of the IHS to tropospheric measurements of NH<sub>3</sub> and O<sub>3</sub> are feasible with measurement precisions ranging from 0.5 to 2 ppb and 20 to 30 ppb, respectively. These analyses have included effects of potential retrieval-error sources and have resulted in specifications of measurement modes, optimum signature lines, required system parameters, and expected sensitivities. Preliminary instrument performance data are presented. (Author)

**A76-25911 \*** Remote sensing of atmospheric SO<sub>2</sub> using the differential absorption LIDAR technique. J. M. Hoell, Jr., W. R. Wade (NASA, Langley Research Center, Hampton, Va.) and R. T. Thompson, Jr. (Old Dominion University, Norfolk, Va.). In: International Conference on Environmental Sensing and Assessment, Las Vegas, Nev., September 14-19, 1975, Proceedings. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1976, p. 1 10-6 to 8 10-6. 15 refs.

The paper reports an investigation of the capabilities of a UV differential absorption lidar (DIAL) system for remote measurements

of sulfur dioxide emissions. Two features of the present DIAL system are an absorption cell permitting the determination of the difference in SO<sub>2</sub> absorption coefficients for the two transmitted wavelengths and a calibration cell permitting the linearity and performance of the system to be evaluated. The DIAL technique is described along with the transmitter, receiver, data-acquisition, and data-processing components of the investigated system. Quantitative measurements of the average SO<sub>2</sub> concentration in a region surrounding the exhaust stack of a steam-generating plant are discussed which show that the present system has measurement sensitivities of 10 ppb at a range of 0.8 km and 20 ppb at 1.9 km. Based on performance characteristics obtained during a calibration of this system, it is predicted that a measurement sensitivity of less than 4 ppb over a 1-km path will be attained. F.G.M.

**A76-25912** Total atmospheric column and tropospheric abundance measurement of nitrogen dioxide by absorption spectroscopy. W. R. Henderson (NOAA, Aeronomy Laboratory, Boulder, Colo.). In: International Conference on Environmental Sensing and Assessment, Las Vegas, Nev., September 14-19, 1975, Proceedings. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1976, p. 1 10-7 to 3 10-7.

The optical absorption feature of NO<sub>2</sub> is used to identify and measure the amount of NO<sub>2</sub> in the path between a light source and the point of observation. Two methods have been used to observe the NO<sub>2</sub> absorption. The first method utilized an incandescent light source with a path length of 10 km. The second method uses the sun as a source which allows the entire atmospheric column to be observed. In both methods of observation, a spectrum of the light source is analyzed by least-squares fit to known spectra in order to identify components due to NO<sub>2</sub> absorption and to measure the magnitude of this effect. Absorption features due to water vapor and Rayleigh scattering must also be measured and included in the calculation of the NO<sub>2</sub> absorption in order to remove their interference. Absolute calibration for the number of NO<sub>2</sub> atoms in the observed light path is obtained by measuring a spectrum while observing through a cell containing a known NO<sub>2</sub> concentration. Measurement of NO<sub>2</sub> absorption with the sun as a source as the sun sets allows an altitude profile of NO<sub>2</sub> to be inferred. (Author)

**A76-25921 \*** Remote sensing of ground and surface water contamination by leachate from landfill. D. A. Sangrey, W. L. Teng, W. R. Philipson, and T. Liang (Cornell University, Ithaca, N.Y.). In: International Conference on Environmental Sensing and Assessment, Las Vegas, Nev., September 14-19, 1975, Proceedings. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1976, p. 1 15-1 to 5 15-1. Research supported by the New York State Department of Environmental Conservation and U.S. Environmental Protection Agency; Grant No. NGL-33-010-171.

**A76-25924** Investigation of exit areas of groundwater related to anthracite deep mines. C. A. Petrus (HRB-Singer, Inc., State College, Pa.). In: International Conference on Environmental Sensing and Assessment, Las Vegas, Nev., September 14-19, 1975, Proceedings. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1976, p. 1 15-6 to 4 15-6. 9 refs. Research supported by the HRB-Singer, Inc. and U.S. Bureau of Mines.

By using a thermal-scanning system, it is now feasible to locate mine-water discharges that were once difficult to establish solely through extensive ground reconnaissance. The Eastern Pennsylvania Southern Anthracite Field, where the major anthracite reserves are located, was selected as the study area to demonstrate this technique. In the Southern Anthracite Field, the relationship of groundwater to the level of mine-water pools, and the subsequent exit of such water into major streams, is detected by the application of established interpretation techniques to airborne thermal imagery. The method provides a rapid and efficient means of locating point sources and seep zones prior to the initiation of a ground survey. Since the mine-water discharge problem is probably the single most critical

physical factor limiting the development of increased anthracite production, this study was undertaken to produce a compendium of surface and groundwater discharges in the area of anticipated anthracite coal production. (Author)

**A76-25925** Assessment of the benefits of environmental remote sensing. A. Hershaft (Enviro Control, Inc., Rockville, Md.). In: International Conference on Environmental Sensing and Assessment, Las Vegas, Nev., September 14-19, 1975, Proceedings. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1976, p. 1 16-1 to 6 16-1.

This paper presents a method for estimating the incremental benefits accruing from the application of remote-sensing information to the more promising areas of environmental management. The scope of these benefits is defined both by the needs of environmental-management decisions and by the projected capabilities of the remote-sensing system. The method is illustrated by a case study designed to assess the environmental benefits of data supplied by a continuing Earth Resources Survey mission in the 1977-1986 time frame. (Author)

**A76-25927 \*** Evaluation of water samples collected during LANDSAT-1 overpasses of the lower Chesapeake Bay area. D. E. Bowker and W. G. Witte (NASA, Langley Research Center, Hampton, Va.). In: International Conference on Environmental Sensing and Assessment, Las Vegas, Nev., September 14-19, 1975, Proceedings. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1976, p. 1 16-3 to 5 16-3.

Water samples were collected on 18 days when the LANDSAT-1 satellite was passing over the lower Chesapeake Bay area. A correlation between the various water parameters has been performed for the more than 300 surface samples. Six days were sufficiently cloudless that MSS digital tapes were useful for analysis. Correlation of radiance values with the water parameters revealed a low correlation for chlorophyll and good correlations with particles and sediment. The relation of total particles to sediment was linear, but varied from day to day. (Author)

**A76-25928 \*** Remote sensing of trace constituents from atmospheric infrared emission and absorption spectra. D. B. Barker, J. N. Brooks, A. Goldman, J. J. Kesters, D. G. Murcray, F. H. Murcray, J. Van Allen, and W. J. Williams (Denver, University, Denver, Colo.). In: International Conference on Environmental Sensing and Assessment, Las Vegas, Nev., September 14-19, 1975, Proceedings. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1976, p. 1 16-6 to 7 16-6. 14 refs. Research supported by the U.S. Department of Transportation, U.S. Air Force, NSF, and NASA.

Atmospheric infrared emission and absorption spectra obtained from aircraft and balloon-borne spectrometers are presented. From such spectra, mixing ratio vs altitude profiles are derived for several minor constituents. Recent results for HNO<sub>3</sub>, CF<sub>2</sub>Cl<sub>2</sub>, CFCI<sub>3</sub>, and HF are presented. In addition, the feasibility of infrared detection of other trace constituents, such as HCl, HF, NH<sub>3</sub>, NO and SO<sub>2</sub>, against the rest of the atmospheric background is studied. From this study, made on a line-by-line basis for 'state of the art' airborne spectrometers, potential spectral features for detection of the trace constituents are isolated. (Author)

**A76-25932 \*** Monitoring of environmental effects of coal strip mining from satellite imagery. R. L. Brooks (EG & G/Washington Analytical Services Center, Las Cruces, N. Mex.) and C. G. Parra (New Mexico State University, Las Cruces, N. Mex.). In: International Conference on Environmental Sensing and Assessment, Las Vegas, Nev., September 14-19, 1975, Proceedings. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1976, p. 1 17-4 to 4 17-4. 7 refs. Contract No. NAS9-13310.

This paper evaluates satellite imagery as a means of monitoring coal strip mines and their environmental effects. The satellite

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imagery employed is Skylab EREP S-190A and S-190B from SL-2, SL-3 and SL-4 missions; a large variety of camera/film/filter combinations has been reviewed. The investigation includes determining the applicability of satellite imagery for detection of disturbed acreage in areas of coal surface mining as well as the much more detailed monitoring of specific surface-mining operations, including: active mines, inactive mines, highwalls, ramp roads, pits, water impoundments and their associated acidity, graded areas and types of grading, and reclaimed areas. Techniques have been developed to enable mining personnel to utilize this imagery in a practical and economic manner, requiring no previous photo-interpretation background and no purchases of expensive viewing or data-analysis equipment. To corroborate the photo-interpretation results, on-site observations were made in the very active mining area near Madisonville, Kentucky. (Author)

**A76-25933**      **Aerial remote sensing applications in support of oil spill cleanup, control and prevention.** D. Jones (U.S. Environmental Protection Agency, Washington, D.C.), R. Landers, and A. Pressman (U.S. Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Las Vegas, Nev.). In: International Conference on Environmental Sensing and Assessment, Las Vegas, Nev., September 14-19, 1975, Proceedings. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1976, p. 1 17-5 to 4 17-5.

The paper discusses the aerial remote-sensing surveillance systems being used by the Environmental Protection Agency and the Coast Guard for detecting oil discharges and mapping the extent of major oil spills in support of clean-up and control operations as well as environmental damage assessment. Noting that the Santa Barbara Channel oil-pollution incident in 1969 provided the initial impetus for remote sensing of oil spills, the responsibilities of the Coast Guard and EPA in this area are outlined. The functions of the Coast Guard's Airborne Oil Surveillance System are summarized, the system components are described, and a scenario of the standard response to a major oil spill is given. Some photographs taken during recent oil spills in the Gulf of Mexico, the Mississippi River, and the Delaware River are presented. The use of aerial surveys in support of compliance inspections of onshore and offshore storage facilities is discussed. F.G.M.

**A76-25937**      **Estimation of point source emission strengths with aircraft.** J. E. Cunningham, W. F. Harris, J. W. Key, and C. D. Wolbach (Texas Air Control Board, Austin, Tex.). In: International Conference on Environmental Sensing and Assessment, Las Vegas, Nev., September 14-19, 1975, Proceedings. Volume 1. New York, Institute of Electrical and Electronics Engineers, Inc., 1976, p. 1 18-6 to 4 18-6.

The paper presents an evaluation of aerial sampling as a means of determining point-source emissions. The use of aircraft for source-status determinations is discussed along with the development of adequate instrumentation for measuring pollutants, an appropriate methodology for flying the aircraft, the recognition and measurement of other parameters needed in calculating emission rates, and the mathematical reduction of collected data. Some statistical data are given for aerial sampling operations that were carried out to determine SO<sub>2</sub> emissions from several industrial plants. It is concluded that aerial sampling can be used to determine emission-source strengths to good precision and that this technique is more cost effective and more versatile than standard sampling techniques. F.G.M.

**A76-25957**      **The Environmental Information System /EIS/ in Sweden and monitoring of the environment.** I. Palmiund and I. Andersson (Swedish Council of Environmental Information, Stockholm, Sweden). In: International Conference on Environmental Sensing and Assessment, Las Vegas, Nev., September 14-19, 1975, Proceedings. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1976, p. 1 25-2 to 3 25-2.

**A76-25963 \***      **An automated atmospheric sampling system operating on 747 airliners.** P. J. Perkins (NASA, Lewis Research Center, Cleveland, Ohio) and U. R. C. Gustafsson (United Airlines, San Francisco, Calif.). In: International Conference on Environmental Sensing and Assessment, Las Vegas, Nev., September 14-19, 1975, Proceedings. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1976, p. 1 26-4 to 10 26-4. 9 refs.

An air sampling system that automatically measures the temporal and spatial distribution of particulate and gaseous constituents of the atmosphere is collecting data on commercial air routes covering the world. Measurements are made in the upper troposphere and lower stratosphere (6 to 12 km) of constituents related to aircraft engine emissions and other pollutants. Aircraft operated by different airlines sample air at latitudes from the Arctic to Australia. This unique system includes specialized instrumentation, a special air inlet probe for sampling outside air, a computerized automatic control, and a data acquisition system. Air constituent and related flight data are tape recorded in flight for later computer processing on the ground. (Author)

**A76-25965 \***      **Temporal and spatial changes in ozone from the Nimbus IV BUV experiment.** R. M. Nagatani, A. J. Miller (NOAA, National Meteorological Center, Washington, D.C.), and D. F. Heath (NASA, Goddard Space Flight Center, Greenbelt, Md.). In: International Conference on Environmental Sensing and Assessment, Las Vegas, Nev., September 14-19, 1975, Proceedings. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1976, p. 1 26-6 to 4 26-6.

The paper discusses various aspects of changes in ozone as revealed by Nimbus IV backscatter ultraviolet (BUV) data. An average of all BUV data points over a hemisphere or over the globe yields hemispheric or global ozone budgets. An interesting deviation in such a curve was observed for January, 1971, which is associated with a mid-winter stratospheric warming. Study of standard deviation maps for the months of December and January show the greater variability for January. Relative quiescence of total ozone over Europe is observed, where temperatures in the lower stratosphere remained relatively cold and there were no large changes in circulation. Large-scale variance of the planetary waves in the ozone fields can also be separated into its various wave components from the available maps of BUV data. Variances in the ozone fields are explained in large part by waves 1 and 2 during the warming period, by studying the time change of the phase and amplitude of the waves. P.T.H.

**A76-25976 \***      **Atmospheric aerosole - Characteristics and measurement.** K. T. Whitby and B. Cantrell (Minnesota, University, Minneapolis, Minn.). In: International Conference on Environmental Sensing and Assessment, Las Vegas, Nev., September 14-19, 1975, Proceedings. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1976, p. 1 29-1 to 6 29-1. 25 refs. U.S. Environmental Protection Agency Grant No. R-800971.

Major characteristics of atmospheric aerosols that must be taken into account when selecting, calibrating, and applying aerosol measurement techniques are examined. Particular attention is given to the bimodal mass distribution and chemical separation of fine and coarse particles. Aerosol measurement techniques are classified as to whether the measurement is made in situ or on a sample collected on a surface. Collection methods are discussed relative to filtration and impaction. In situ aerosol measurement is examined in relation to integral instruments, condensation nuclei counter, electrical integral sensors, size resolving, and electrical aerosol analyzer. Further development and more widespread use of in situ measurement techniques are desirable for both physical and chemical measurements. S.D.

**A76-25986**      **Cloud condensation nuclei from a paper mill - Their effects on clouds and precipitation.** E. E. Hindman, II (U.S.

Naval Weapons Center, China Lake, Calif.) and P. V. Hobbs (Washington, University, Seattle, Wash.). In: International Conference on Environmental Sensing and Assessment, Las Vegas, Nev., September 14-19, 1975, Proceedings. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1976, p. 1 32-3 to 4 32-3. 7 refs.

The relationship between cloud condensation nuclei (CCN) size distributions observed in the plume of a paper mill and cloud droplet size distributions observed in small nonraining warm clouds located downwind is studied. The effect of the anthropogenic CCN on rainfall from these warm clouds is evaluated using a one-dimensional computer model designed to simulate the life-cycle of warm cumulus clouds. It is shown that CCN broaden droplet size distributions and that the broader drop size distribution has no significant effect on the total rainfall from a warm cumulus cloud in a Florida-type environment. S.D.

**A76-25990** A comprehensive environmental monitoring system as a tool for impact assessment and operational compliance. G. R. Goldgraben and W. B. Montano (NUS Corp., Rockville, Md.). In: International Conference on Environmental Sensing and Assessment, Las Vegas, Nev., September 14-19, 1975, Proceedings. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1976, p. 1 33-3 to 8 33-3. 8 refs.

The design and capabilities of a fully automated, integrated, environmental monitoring and data handling system are described. The system is configured to enable the ambient air quality, source emission, meteorology, and water quality to be monitored simultaneously, each at multiple locations. The heart of the overall system is a minicomputer with local subsystem control effected by digital microprocessors. Transmission methods can be via hardware, telephone dial-up, or radio/microwave. System packaging allows placement in desert areas and under water. The properly integrated system will not only reduce man-hours and thus labor costs but will also provide new useful reliable and more valid reports and control decisions than those available with non-real-time systems. S.D.

**A76-25999 \*** The measurement of carbon monoxide and methane in the National Capital Air Quality Control Region. I - Measurement systems. P. J. LeBel (NASA, Langley Research Center, Hampton, Va.), R. A. Lamontagne (U.S. Navy, Naval Research Laboratory, Washington, D.C.), and H. W. Goldstein (General Electric Co., Philadelphia, Pa.). In: International Conference on Environmental Sensing and Assessment, Las Vegas, Nev., September 14-19, 1975, Proceedings. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1976, p. 1 35-1 to 4 35-1. 5 refs.

The Carbon Monoxide Pollution Experiment (COPE) and the National Capital Air Quality Control Region (NCAQCR) undertook a series of measurements of atmospheric CO and CH<sub>4</sub> to determine the accuracy of the airborne COPE Correlation Interferometer. The device, a modified Michelson interferometer, measures the atmospheric column density of CO and CH<sub>4</sub> at 2.3 microns with tropospheric measurement sensitivities of 70 and 10 PPB, respectively. Data for evaluating the remote measurements included atmospheric column density measurements at a ground truth site using a van-mounted infrared Fourier spectrometer; continuous ground level gas chromatographic measurements; and chromatographic data from atmospheric grab samples collected by aircraft and at ground locations. The instruments and sampling techniques used in the experiment are described in detail. C.K.D.

**A76-26001 \*** The measurement of carbon monoxide and methane in the national capital air quality control region. III - Correlation interferometer results. H. W. Goldstein, M. H. Bortner, R. N. Grenda (General Electric Co., Philadelphia, Pa.), R. Dick (Barringer Research, Ltd., Rexdale, Ontario, Canada), P. J. LeBel (NASA, Langley Research Center, Hampton, Va.), and R. A. Lamontagne (U.S. Navy, Naval Research Laboratory, Washington,

D.C.). In: International Conference on Environmental Sensing and Assessment, Las Vegas, Nev., September 14-19, 1975, Proceedings. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1976, p. 1 35-3 to 3 35-3. Contract No. NAS1-10139.

Two types of experiments were performed with a correlation interferometer on-board a Bell Jet Ranger 206 Helicopter. The first consisted of simultaneous ground- and air-truth measurements as the instrumented helicopter passed over the Cheverly site. The second consisted of several measurement flights in and around the national capital air quality control region (Washington, D.C.). The correlation interferometer data, the infrared Fourier spectrometer data, and the integrated altitude sampling data showed agreement within the errors of the individual measurements. High values for CO were found from the D.C. flight data to be reproducible and concentrated in areas of stop-and-go traffic. It is concluded, that pollutants at low altitudes are detectable from an air-borne platform by remote correlation interferometry and that the correlation interferometer measurements agree with ground- and air-truth data. (Author)

**A76-26005** Applications of quality assurance in major air pollution monitoring studies - CHAMP and RAMS. D. J. von Lehmden, R. C. Rhodes, and S. Hochheiser (U.S. Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Research Triangle Park, N.C.). In: International Conference on Environmental Sensing and Assessment, Las Vegas, Nev., September 14-19, 1975, Proceedings. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1976, p. 1 36-3 to 5 36-3. 14 refs.

The Community Health Air Monitoring Program (CHAMP) has been established to measure ambient pollutant concentrations and meteorological parameters. Similar measurements are also conducted with the aid of the Regional Air Monitoring System (RAMS). It is pointed out that internal and external quality assurance considerations have been emphasized in the design of CHAMP and RAMS. Attention is given to internal quality assurance activities by the contractor and external quality assurance activities by the U.S. Environmental Protection Agency. G.R.

**A76-26007** Future energy development and related environmental monitoring. S. J. Gage and G. J. D'Alessio (U.S. Environmental Protection Agency, Office of Energy Minerals and Industry, Washington, D.C.). In: International Conference on Environmental Sensing and Assessment, Las Vegas, Nev., September 14-19, 1975, Proceedings. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1976, p. 5 P111-10 P111.

In response to national problems brought about by the energy crisis a report was submitted to the President of the U.S. in December 1973. The report emphasized the need for an environmental assessment of new energy technologies. The report identified also objectives related to environmental monitoring and to associated monitoring methods. In connection with the resulting environmental research and development program, it is the objective of the Western Energy/Environment Monitoring Study to provide current baseline information on air, water, and land quality in the Western U.S. Questions concerning the planning and the implementation of the monitoring study are discussed and attention is given to future energy-related monitoring needs. G.R.

**A76-26253** Use of laser radar in atmospheric investigations /Review/. O. K. Kostko (Tsentral'naya Aerologicheskaya Observatoriya, Dolgoprudny, USSR). (Kvantovaya Elektronika /Moscow/, vol. 2, Oct. 1975, p. 2133-2162.) Soviet Journal of Quantum Electronics, vol. 5, no. 10, 1976, p. 1161-1177. 211 refs. Translation.

Results are presented on the experimental investigations of the atmosphere with the aid of lidars. The discussion covers the use of various types of laser emission scattering in the atmosphere for determining the standard meteorological parameters, composition,

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and pollution level of the atmosphere. Data are provided on laser probing of tropospheric, stratospheric, and mesospheric clouds as well as of cosmic dust. The possibility of using lidars aboard meteorological satellites is discussed. S.D.

**A76-26426** Ionospheric currents obtained from the Chatanika radar and ground magnetic perturbations at the auroral latitude. Y. Kamide, S.-I. Akasofu (Alaska, University, Fairbanks, Alaska), and A. Brekke (Auroral Observatory, Tromsø, Norway). *Planetary and Space Science*, vol. 24, Mar. 1976, p. 193-201. 24 refs. NSF Grants No. GA-36873X; No. DES-74-23832.

**A76-26427** The auroral electrojet and field-aligned current. Y. Kamide and S.-I. Akasofu (Alaska, University, Fairbanks, Alaska). *Planetary and Space Science*, vol. 24, Mar. 1976, p. 203-213. 27 refs. NSF Grants No. GA-36873X; No. DES-74-23832.

The location of field-aligned currents in the evening sector with respect to the auroral electrojets is examined. The tri-axial TRIAD satellite data and the simultaneous ground magnetometer data from along the Alaska meridian are analyzed. It is shown that an intense upward field-aligned current flows out from the region of the westward electrojet where discrete auroras are located. The downward flowing current exists in the region further equatorward, namely, in the region of the eastward electrojet. However, the downward current is present even when there is no eastward electrojet. The boundary between the upward and the downward currents coincides, in most cases, with the boundary between the westward and the eastward auroral electrojets. Thus, the Harang discontinuity, a narrow area separating the positive and negative H bays, is the region where there is no field-aligned current. (Author)

**A76-26707** Subsurface water parameters - Optimization approach to their determination from remotely sensed water color data. S. C. Jain and J. R. Miller (York University, Downsview, Ontario, Canada). *Applied Optics*, vol. 15, Apr. 1976, p. 886-890. 18 refs.

A method using an optimization scheme has been developed for the interpretation of spectral albedo (or spectral reflectance) curves obtained from remotely sensed water-color data. This method uses a two-flow model of the radiation flow and solves for the albedo. Optimization fitting of predicted to observed reflectance data is performed by a quadratic interpolation method for the chlorophyll concentration and scattering coefficient. The technique is applied to airborne water-color data obtained from Kewartha Lakes, the Sargasso Sea, and the Nova Scotia coast. The modeled spectral albedo curves are compared with those obtained experimentally, and the computed optimum water parameters are compared with ground-truth values. It is shown that the backscattered spectral signal contains information that can be interpreted to give quantitative estimates of the chlorophyll concentration and turbidity in the waters studied. (Author)

**A76-27016** Experimental apparatus for studies of the fine structure of low-frequency electromagnetic processes and some results of its tests. I. Ia. L. Al'pert, I. P. Bashilov, G. A. Mikhailova, O. V. Kapustina, and G. P. L'vova. (*Kosmicheskie Issledovaniia*, vol. 13, July-Aug. 1975, p. 544-554.) *Cosmic Research*, vol. 13, no. 4, Jan. 1976, p. 488-496. 6 refs. Translation.

A brief description is given of an experimental apparatus intended for studies of the fine structure of the spectra of wave packets excited in the circumterrestrial plasma and detected near the earth's surface or by satellites. The major component of this apparatus is an analog-to-digital data conversion system. The frequency range of this device is from 40 Hz to 15 kHz, its temporal resolution ranges from 250.10 to 16.10 microsec, and its frequency resolution is between 2 and 64 Hz in various regions of the spectrum of the investigated oscillation processes. Some test results are presented which were obtained using theoretical oscillation processes, laboratory sources, and natural wave packets. F.G.M.

**A76-27023** Excess radiation measured with the Kosmos-137 and Kosmos-219 satellites. E. V. Gorchakov, M. V. Ternovskaia, and V. I. Serverinov. (*Kosmicheskie Issledovaniia*, vol. 13, July-Aug. 1975, p. 605, 606.) *Cosmic Research*, vol. 13, no. 4, Jan. 1976, p. 543, 544. 11 refs. Translation.

**A76-27069** # Synoptic monitoring of the mesopause region using D-region plasma as a tracer in different heights. G. Entzian, E. A. Lauter, and J. Taubenheim (Deutsche Akademie der Wissenschaften, Zentralinstitut für solar-terrestrische Physik, Berlin, East Germany). (*IUGG, IAMAP, and IAGA, Interdisciplinary Symposium on Stratosphere-Mesosphere Relations, Grenoble, France, Aug. 22-Sept. 6, 1975.*) *Zeitschrift für Meteorologie*, vol. 26, no. 1, 1976, p. 1-6. 9 refs.

The analysis of continuous LF phase-height records, in comparison with HF absorption measurements, is used to define the coupling of processes in the mesopause and turbopause regions in their seasonal dependence, particularly in winter. This analysis is able to detect variations of pressure and temperature below the mesopause, and the height changes of the 'winter anomaly region' of electron density above it. Conditions of winter anomaly turn out to be bound to a warm mesopause, whereas temporal breakdowns of the winter anomaly, following stratospheric warmings, generally cause changes similar to those in the transition period from winter to spring (increase of pressure, cooling of the mesopause, and a reversal of the wind system of the lowest thermosphere). (Author)

**A76-27105** Remote temperature profiling in the lower troposphere. M. S. Frankel (Stanford University, Stanford, Calif.) and A. M. Peterson (Stanford Research Institute, Menlo Park, Calif.). *Radio Science*, vol. 11, Mar. 1976, p. 157-166. 21 refs. Research supported by the Stanford Research Institute; Contract No. N00014-67-A-0112-0044.

Advantages of the radio-acoustic sounding system (RASS) in real-time measurements of temperature profiles, and as a meteorological instrument, are discussed. The history, underlying theory, system configuration, data reduction and transmission, and future outlook of the RASS are covered. Doppler tracking of an acoustic pulse by electromagnetic radar is the basic feature of the system. A narrow-beam folded-horn array designed for RASS, with high efficiency and weatherproof operation, is described. Available RASS units reliably measure temperature profiles to heights of over 3 km at winds from near zero and to heights of 800 m at heavy winds. R.D.V.

**A76-27269** \* Correlation between microwave scattering and emission from land and sea at 13.9 GHz. A. Sobti (Motorola, Inc., Communications Div., Schaumburg, Ill.) and R. K. Moore (University of Kansas Center for Research, Inc., Lawrence, Kan.). (*International Union of Radio Science, Annual Meeting, Boulder, Colo., Oct. 20-23, 1975.*) *IEEE Transactions on Geoscience Electronics*, vol. GE-14, Apr. 1976, p. 93-96. 5 refs. Contract No. NAS9-13331.

Correlations have been calculated between active and passive microwave responses received by the S-193 radiometer-scatterometer on Skylab. Over both land and sea, the correlations between polarizations are high, but the correlation between radiometer and scatterometer response at 30-deg incidence is negligible. This suggests that multipolarization instruments with this crude resolution (greater than 10 km in all cases) are redundant, but a combination of radiometer and scatterometer is useful. Correlations among the responses at different angles suggest that the five angles used in Skylab are more than would be useful between zero and 48 deg in future instruments, but that instruments with three angles of measurement would be useful. In small areas, conclusions based on these large-data-set averages may need to be modified. (Author)

**A76-27423** Landsat patterns considered in relation to Australian resources surveys. R. Story, G. A. Yapp, and A. T. Dunn (Commonwealth Scientific and Industrial Research Organization, Div. of Land Use Research, Canberra, Australia). *Remote Sensing of Environment*, vol. 4, no. 4, 1976, p. 281-303. 12 refs.



Landsat I imagery was evaluated by three workers operating independently and without field checks or reference to literature data. The results were compared to a previously performed conventional survey of an arid region where the survey area was mapped and described in terms of homogeneous subdivisions (land systems) by means of stereo examination of black-and-white aerial photography supplemented by field work. The mapping obtained by these workers established about half as many patterns and occurrences of patterns as were found on the same area of the survey map. The results indicate that Landsat I imagery could play a worthwhile part in surveys of arid regions at approximately 1:1,000,000 scale, especially through quick and easy mapping of large areas of uniform country and through indicating complex areas where more intensive study was needed. S.D.

**A76-28061** Reflectivity of the earth's surface near the interface of two uniform areas. A. A. Buznikov, K. Ia. Kondrat'ev, and O. I. Smoktii (Leningradskii Gosudarstvennyi Universitet, Leningrad, USSR). In: Remote sensing of earth resources. Volume 4 - Proceedings of the Fourth Annual Conference on Earth Resources, Tullahoma, Tenn., March 24-26, 1975. Tullahoma, University of Tennessee, 1975, p. 161-176. 8 refs.

The problem of the formation of reflection spectra near the sand shore-water surface interface is considered using the 'Soyuz-9' spacecraft data obtained during the spectrophotometric measurements of the surface in the region of the cape Bekdash (coast of the Caspian sea). The data show the possibility of the reliable location, with the use of the spectral brightness curves obtained from space, of the interface between two uniform semiplanes with different albedo and the feasibility of the determination of the characteristic linear dimensions of the optically nonuniform 'boundary zone' situated on both sides of the interface. The results obtained are also useful for the estimation of the 'contamination' of certain surface reflection spectra by the adjacent areas of the surface which have different optical properties. Such estimates are important for the solution of the problem of object recognition. (Author)

**A76-28064** Land use discrimination employing remote multispectral sensing techniques. G. E. Johnson (Indiana State University, Terre Haute, Ind.; North Dakota University, Grand Forks, N. Dak.) and C. J. Johannsen (Purdue University, West Lafayette, Ind.; Missouri, University, Columbia, Mo.). In: Remote sensing of earth resources. Volume 4 - Proceedings of the Fourth Annual Conference on Earth Resources, Tullahoma, Tenn., March 24-26, 1975. Tullahoma, University of Tennessee, 1975, p. 233-242. 5 refs.

Remotely sensed data collected by an airborne multichannel optical mechanical scanner operating at 5000 feet were processed and evaluated by computer techniques developed at the Laboratory for Applications of Remote Sensing (LARS). Multispectral data were collected in 13 discrete wave bands ranging from .40 to 2.60 microns wavelength. The capability of the technique to discriminate between nine classes of rural land use cover types was determined on the basis of test field performance evaluation. The nine classes of land use cover types selected included corn, soybeans, wheat, oats, hay, pasture, trees, water, and bare soil. Identification accuracy ranged from 57.9% correct recognition for pasture to 99.7% correct recognition for water under conditions present at the time of data collection. (Author)

**A76-28065** Regional interpretability variations of land use using satellite data in digital and visual form. D. E. Schwarz (San Jose State University, San Jose, Calif.) and L. Gaydos (U.S. Geological Survey, Menlo Park, Calif.). In: Remote sensing of earth resources. Volume 4 - Proceedings of the Fourth Annual Conference on Earth Resources, Tullahoma, Tenn., March 24-26, 1975. Tullahoma, University of Tennessee, 1975, p. 243-253.

It is argued that regional variations of landscape complexity, affected by such factors as cloud coverage, climate, vegetation, land survey pattern and urban morphology lead to differences in the

interpretability of satellite remote-sensor imagery. Landscape complexity - physically and culturally conditioned - should determine the form (visual or digital) of the image interpretation technique. This choice between visual and digital can be made by categorizing three groups of spectral variability (intra-pixel variability, pixel uniformity and inter-pixel uniformity) of satellite imagery determined by landscape complexity. B.J.

**A76-28068 \*** A wetlands inventory of the state of Nebraska using ERTS-1 imagery. P. M. Seevers, R. M. Peterson, D. J. Mahoney, D. G. Maroney, and D. C. Rundquist (Nebraska University, Lincoln, Neb.). In: Remote sensing of earth resources. Volume 4 - Proceedings of the Fourth Annual Conference on Earth Resources, Tullahoma, Tenn., March 24-26, 1975. Tullahoma, University of Tennessee, 1975, p. 281-292. 6 refs. Research supported by the Nebraska Game and Parks Commission; Grant No. NGL-28-004-020.

The use of ERTS-1 imagery permitted a rapid, economic, and accurate inventory of wetlands in Nebraska that are ten acres or larger in size. Four categories of wetlands - Open Water, Subirrigated Meadows, Marshes, and Seasonally Flooded Basins - were delineated by using two seasons of imagery and an electronic image-enhancing system. Positive print enlargements of bands 5 and 7 at a scale of 1:250,000 (acquired in the spring) as well as band 7 (acquired in late summer) were used to delineate all categories. Electronic enhancement of band 6 (acquired in the fall) was used as an aid to further differentiate marshes. Accuracy estimates based on color infrared aerial photography as ground truth indicated, as an overall average, 85 percent correct identification. (Author)

**A76-28076** Detection of gypsy moth (*Porthetria dispar*) damage with high altitude aircraft and satellite data. W. G. Rohde (EROS Data Center, Sioux Falls, S. Dak.), T. W. D. Gregg (Earth Satellite Corp., Washington, D.C.), and H. J. Moore (U.S. Department of Agriculture, Animal Plant Health Inspection Services, Hyattsville, Md.). In: Remote sensing of earth resources. Volume 4 - Proceedings of the Fourth Annual Conference on Earth Resources, Tullahoma, Tenn., March 24-26, 1975. Tullahoma, University of Tennessee, 1975, p. 403-430. 9 refs.

**A76-28077** The use of land resource satellite sensors for air and water pollution measurement. H. B. Hallock (Grumman Aerospace Corp., Bethpage, N.Y.). In: Remote sensing of earth resources. Volume 4 - Proceedings of the Fourth Annual Conference on Earth Resources, Tullahoma, Tenn., March 24-26, 1975. Tullahoma, University of Tennessee, 1975, p. 431-467.

51 refs. Research sponsored by the Grumman EOS Program.

Specifications for the Earth Observatory Satellite (EOS) Thematic Mapper (TM) and High Resolution Pointable Imager (HRPI) are compared to the air and water quality signature requirements. It is shown that the effectiveness of the HRPI for mapping atmospheric aerosols and water turbidity should be supplemented for air pollution monitoring by the use of the infrared bands of the TM. The effectiveness of the infrared bands depends on the ground-based calibrated beacons of the narrow spectral band laser type. Both blackbody and laser ground-based beacons can be used with the two sensors under discussion and are particularly effective on the dark side of the earth. The use of near-polar, near-terminator type orbits for the mapping of stratospheric aerosols and other pollutants on a global scale is discussed. The incorporation of spectro-polarimetric capability in the spectral channels of the sensors is considered. B.J.

**A76-28079 \*** Application of remote sensing to thermal pollution analysis. H. W. Hiser, S. S. Lee, T. N. Veziroglu, and S. Sengupta (Miami University, Coral Gables, Fla.). In: Remote sensing of earth resources. Volume 4 - Proceedings of the Fourth Annual Conference on Earth Resources, Tullahoma, Tenn., March 24-26, 1975. Tullahoma, University of Tennessee, 1975, p. 481-497. 20 refs. Contract No. NAS10-8740.



## 02 ENVIRONMENTAL CHANGES AND CULTURAL RESOURCES

A comprehensive numerical model development program for near-field thermal plume discharge and far field general circulation in coastal regions is being carried on at the University of Miami Clean Energy Research Institute. The objective of the program is to develop a generalized, three-dimensional, predictive model for thermal pollution studies. Two regions of specific application of the model are the power plants sites at the Biscayne Bay and Hutchinson Island area along the Florida coastline. Remote sensing from aircraft as well as satellites are used in parallel with in situ measurements to provide information needed for the development and verification of the mathematical model. This paper describes the efforts that have been made to identify problems and limitations of the presently available satellite data and to develop methods for enhancing and enlarging thermal infrared displays for mesoscale sea surface temperature measurements. (Author)

**A76-28081** Kansas water quality using ERTS-1. J. R. McCauley and H. L. Yarger (University of Kansas Center for Research, Inc., Lawrence, Kan.). In: Remote sensing of earth resources. Volume 4 - Proceedings of the Fourth Annual Conference on Earth Resources, Tullahoma, Tenn., March 24-26, 1975. Tullahoma, University of Tennessee, 1975, p. 521-541.

8 refs.

Two Kansas reservoirs have been the object of intensive study to determine the properties of reservoirs which control the spectral intensity of reflected sunlight as detected by the ERTS-1 sensors. Water samples have been collected from these two lakes concurrent with satellite overpass and have been analyzed to determine the amount of suspended solids, chlorophyll content, and concentrations of phosphate, nitrate, and potassium ions. In addition, water temperature and turbidity at each sample site were measured. ERTS images in four spectral bands were regularly received for each satellite. CCTs (computer compatible tapes) have been obtained retrospectively for most of the usable passes over the two lakes. ERTS MSS ratios derived from CCTs have been found to be very effective for quantitative detection of suspended solids up to at least 900 ppm. Dissolved solids concentrations up to 500 ppm and algal nutrients up to 20 ppm are not detectable. (Author)

**A76-28088 \*** Use of LARS System for the quantitative determination of smoke plume lateral diffusion coefficients from ERTS images of Virginia. R. N. Blais, G. E. Copeland, and T. H. Lerner (Old Dominion University, Norfolk, Va.). In: Remote sensing of earth resources. Volume 4 - Proceedings of the Fourth Annual Conference on Earth Resources, Tullahoma, Tenn., March 24-26, 1975. Tullahoma, University of Tennessee, 1975, p. 621-633. 5 refs. Grant No. NGL-47-003-067.

**A76-28385** Global distribution of the 'surface albedo' (Globale Verteilung der 'Oberflächenalbedo'). A. Baumgartner, W. Metz (München, Universität, Munich, West Germany), and H. Mayer (Forstliche Forschungsanstalt, Munich, West Germany). *Meteorologische Rundschau*, vol. 29, Apr. 1976, p. 38-43. 23 refs. In German. Research supported by the Deutsche Forschungsgemeinschaft.

Global charts of the mean distribution of the surface albedo for the months of January and July and for the entire year are compiled on the basis of literature data for the albedo of various land water surfaces. The computed global mean of the albedo is 16.7%. V.P.

**N76-16261** Science Research Council. Slough (England). Appleton Lab.

### **LAND, SEA AND ATMOSPHERIC THERMAL NOISE**

P. G. Davies. In AGARD Electromagnetic Noise Interference and Compatibility Nov. 1975 15 p refs

Thermal emission is reviewed for the natural environment within the microwave, far infrared and medium infrared bands of the E-M spectrum down to a wavelength of about 3 micron

where reflection of solar radiation begins to predominate. The emphasis is primarily on the fundamental aspects of the emissive properties of the atmosphere and various surfaces and the relationship of this thermal emission to the thermal, absorptive and scattering properties of the atmosphere in slant path propagation. A nomogram technique for determining the noise signal at a point in the atmosphere is considered and a bibliography of recent work on thermal emission is included. Author

**N76-16512\*#** Department of the Environment, Ottawa (Ontario). Applied Hydrology Div.

### **RETRANSMISSION OF HYDROMETRIC DATA IN CANADA Progress Report, Jan. - Jun. 1975**

R. A. Halliday, Principal Investigator, I. A. Reid, and R. O. Christie Aug. 1975 12 p Sponsored by NASA ERTS (E76-10089; NASA-CR-145992) Avail: NTIS HC \$3.50 CSCL 14B

**N76-16516\*#** Meteorological Service of Canada, Ottawa (Ontario). Natural Resources Dept.

### **EVALUATION OF THE FEASIBILITY OF USING THE DATA COLLECTION SYSTEM TO OPERATE A NETWORK OF HYDROLOGICAL AND CLIMATOLOGICAL STATIONS AT SITES REMOTE FROM NORMAL COMMUNICATION LINKS Final Report, Jul. 1972 - May 1974**

Raymond Perrier, Principal Investigator May 1974 15 p Sponsored by NASA ERTS (E76-10093; NASA-CR-145996) Avail: NTIS HC \$3.50 CSCL 14B

The author has identified the following significant results. The General Electric DCP has proven to be a versatile, rugged piece of hardware and has surpassed original expectation; it is very simple to use and does not require skilled staff for its use, installation, and operation. It is well suited for use in remote sites where no power is available. From this experience, it is concluded that the data collection system will be very useful in operating a network of hydrometeorological stations situated in sites remote from normal communication links.

**N76-16518\*#** Department of Industry, London (England). **MESOSCALE ASSESSMENTS OF CLOUD AND RAINFALL OVER THE BRITISH ISLES**

Eric C. Barrett, Principal Investigator and Colin K. Grant Dec. 1975 29 p refs Sponsored by NASA and United Kingdom Dept. of Industry ERTS (E76-10095; NASA-CR-145998) Avail: NTIS HC \$4.00 CSCL 04B

**N76-16519\*#** National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.

### **SATELLITE INFORMATION ON ORLANDO, FLORIDA**

John W. Hannah, Principal Investigator (Brevard County Planning Dept. Fla.)02(Brevard County Planning Dept., Fla.), Garland L. Thomas, and Fernando Esparza 11 Jun. 1975 25 p refs Presented at Earth Resources Survey Symp., Houston, 11 Jun. 1975 Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS (E76-10096; NASA-TM-X-72915) Avail: NTIS HC \$3.50 CSCL 05B

The author has identified the following significant results. Computer classification, accompanied by human interpretation and manual simplification, can produce land use maps which are useful on a regional, county, and for special purpose, a city basis. Change monitoring is potentially an effective application of such data at all planning levels.

**N76-16525\*#** Bureau of Reclamation, Denver, Colo. **USE OF THE LANDSAT-2 DATA COLLECTION SYSTEM IN THE COLORADO RIVER BASIN WEATHER MODIFICATION PROGRAM Progress Report, 1 Jan. - 31 Mar. 1975**

## 02 ENVIRONMENTAL CHANGES AND CULTURAL RESOURCES

Archie M. Kahan, Principal Investigator 31 Mar. 1975 11 p ERTS  
(E76-10102; NASA-CR-146035) Avail: NTIS HC \$3.50 CSCL 04B

The author has identified the following significant results. The LANDSAT data collection system has proven itself to be a valuable tool for control of cloud seeding operations and for verification of weather forecasts. These platforms have proven to be reliable weather resistant units suitable for the collection of hydrometeorological data from remote severe weather environments. The detailed design of the wind speed and direction system and the wire-wrapping of the logic boards were completed.

**N76-16529\*#** Colorado Univ., Boulder.  
**MULTIPLE RESOURCE EVALUATION OF REGION 2, US FOREST SERVICE LANDS UTILIZING LANDSAT MSS DATA Quarterly Progress Report, 1 Sep. - 30 Nov. 1975**  
Paula V. Krebs, Principal Investigator and Roger M. Hoffer (Purdue Univ.) 30 Nov. 1975 27 p refs Prepared in cooperation with Purdue Univ. and Forest Service, Denver ERTS (Contract NAS5-20948)  
(E76-10106; NASA-CR-146039) Avail: NTIS HC \$4.00 CSCL 08B

**N76-16530\*#** Colorado Univ., Boulder.  
**MULTIPLE RESOURCE EVALUATION OF REGION 2, US FOREST SERVICE LANDS UTILIZING LANDSAT MSS DATA Quarterly Progress Report, 1 Jun. - 31 Aug. 1975**  
Paula V. Krebs, Principal Investigator and Roger M. Hoffer (Purdue Univ.) 31 Aug. 1975 27 p refs Prepared in cooperation with Purdue Univ. and Forest Service, Denver ERTS (Contract NAS5-20948)  
(E76-10107; NASA-CR-146040) Avail: NTIS HC \$3.50 CSCL 08B

**N76-16532\*#** Texas Univ., Austin.  
**DEVELOPMENT AND APPLICATION OF OPERATIONAL TECHNIQUES FOR THE INVENTORY AND MONITORING OF RESOURCES AND USES FOR THE TEXAS COASTAL ZONE Quarterly Report, Jun. - Aug. 1975**  
Ron Jones, Principal Investigator (General Land Office, Austin, Tex.), Peggy Harwood (General Land Office, Austin, Tex.), Pat Malin (General Land Office, Austin, Tex.), Koren Sherrill (General Land Office, Austin, Tex.), Jerry Wermund, David Murphy (Texas Water Development Board, Austin), and Paul Shank (Texas Parks and Wildlife Dept., Austin) Sep. 1975 162 p refs ERTS (Contract NAS5-20986)  
(E76-10109; NASA-CR-146042) Avail: NTIS HC \$6.75 CSCL 08B

**N76-16533\*#** Texas Univ., Austin.  
**DEVELOPMENT AND APPLICATION OF OPERATIONAL TECHNIQUES FOR THE INVENTORY AND MONITORING OF RESOURCES AND USES FOR THE TEXAS COASTAL ZONE Quarterly Report, Sep. - Nov. 1975**  
Ron Jones, Principal Investigator (General Land Office, Austin, Tex.), Peggy Harwood (General Land Office, Austin, Tex.), Robert Finley, David Murphy (Texas Water Development Board, Austin), and Robert K. Holz Dec. 1975 60 p refs ERTS (Contract NAS5-20986)  
(E76-10110; NASA-CR-146043) Avail: NTIS HC \$4.50 CSCL 08B

The author has identified the followed significant results. Techniques for interpretation of LANDSAT images were developed, along with a modified land use classification scheme.

**N76-16535\*#** Earth Satellite Corp., Washington, D.C.  
**STUDY OF MESOSCALE EXCHANGE PROCESSES UTILIZ-**

**ING LANDSAT AIR MASS CLOUD IMAGERY Interim Report, Sep. - Nov. 1975**  
Earl S. Merritt and Romeo R. Sabatini, Principal Investigators Dec. 1975 10 p ERTS (Contract NAS5-20944)  
(E76-10112; NASA-CR-146045) Avail: NTIS HC \$3.50 CSCL 04B

**N76-16542\*#** South Dakota State Univ., Brookings. Remote Sensing Inst.  
**INVESTIGATION OF REMOTE SENSING TECHNIQUES AS INPUTS TO OPERATIONAL RESOURCE MANAGEMENT MODELS Interim Report, 11 Sep. - 10 Dec. 1975**  
F.A. Schmer, Principal Investigator, and R.E. Isakson Dec. 1975 27 p Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S.D. 57198 ERTS (Contract NAS5-20982)  
(E76-10119; NASA-CR-146052; SDSU-RSI-75-15) Avail: NTIS HC \$3.50 CSCL 08F

**N76-16543\*#** Zurich Univ. (Switzerland). Dept. of Geography.  
**NATURAL RESOURCES INVENTORY AND LAND EVALUATION IN SWITZERLAND Quarterly Reports**  
Harold Haefner, Principal Investigator [1975] 22 p refs Sponsored by NASA. Original contains color illustrations ERTS (E76-10120; NASA-CR-146053; QR-1; QR-2) Avail: NTIS HC \$3.50 CSCL 08F

The author has identified the following significant results. A system was developed to operationally map and measure the areal extent of various land use categories for updating existing and producing new and actual thematic maps showing the latest state of rural and urban landscapes and its changes. The processing system includes: (1) preprocessing steps for radiometric and geometric corrections; (2) classification of the data by a multivariate procedure, using a stepwise linear discriminant analysis based on carefully selected training cells; and (3) output in form of color maps by printing black and white theme overlays of a selected scale with photomation system and its coloring and combination into a color composite.

**N76-16555\*#** Environmental Research Inst. of Michigan, Ann Arbor. Infrared and Optics Div.  
**OIL POLLUTION DETECTION AND MONITORING FROM SPACE USING SKYLAB Final Report**  
Gary C. Goldman and Robert Horvath, Principal Investigators Nov. 1975 44 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 EREP (Contract NAS9-13281)  
(E76-10133; NASA-CR-144502; ERIM-101800-20-F) Avail: NTIS HC \$4.00 CSCL 13B

**N76-16559\*#** South Dakota State Univ., Brookings. Remote Sensing Inst.  
**USE OF REMOTE SENSING TECHNOLOGY FOR INVENTORYING AND PLANNING UTILIZATION OF LAND RESOURCES IN SOUTH DAKOTA Annual Progress Report, 1 Jul. 1974 - 30 Jun. 1975**  
30 Jun. 1975 52 p refs (Grant NGL-42-003-007)  
(NASA-CR-146144) Avail: NTIS HC \$4.50 CSCL 08B

A project was undertaken in Meade County, South Dakota to provide (1) a general county-wide resource survey of land use and soils and (2) a detailed survey of land use for the environmentally sensitive area adjacent to the Black Hills. Imagery from LANDSAT-1 was visually interpreted to provide land use information and a general soils map. A detailed land use map for the Black Hills area was interpreted from RB-57 photographs and interpretations of soil characteristics were input into a

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computer data base and mapped. The detailed land use data were then used in conjunction with soil maps to provide information for the development of zoning ordinance maps and other land use planning in the Black Hills area. The use of photographs as base maps was also demonstrated. In addition, the use of airborne thermography to locate spoilage areas in sugar beet piles and to determine the apparent temperature of rooftops was evaluated. Author

**N76-16585\*** Army Cold Regions Research and Engineering Lab., Hanover, N.H.

### RED AND NEAR-INFRARED SPECTRAL REFLECTANCE OF SNOW

Harold W. OBrien and Richard H. Munis /in NASA. Goddard Space Flight Center Operational Appl. of Satellite Snowcover Observations 1975 p 345-360 refs

(Paper-24) CSCL 08L

The spectral reflectance of snow in the range of 0.60 to 2.50 microns wavelengths was studied in a cold laboratory using natural snow and simulated preparations of snow. A white barium sulfate powder was used as the standard for comparison. The high reflectance (usually nearly 100%) of fresh natural snow in visible wavelengths declines rapidly at wavelengths longer than the visible, as the spectral absorption coefficients of ice increase. Aging snow becomes only somewhat less reflective than fresh snow in the visible region and usually retains a reflectance greater than 80%. In the near infrared, aging snow tends to become considerably less reflective than fresh snow. Author

**N76-16588\*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

### MICROWAVE EMISSION FROM DRY AND WET SNOW

T. C. Chang and P. Gloersen /in its Operational Appl. of Satellite Snowcover Observations 1975 p 399-407 refs

(Paper-27) CSCL 08L

A microscopic model was developed to study the microwave emission from snow. In this model, the individual snow particles are considered to be the scattering centers. Mie scattering theory for spherical particles is then used to compute the volume scattering and extinction coefficients of the closely packed scattering spheres, which are assumed not to interact coherently. The results of the computations show significant volume scattering effects in the microwave region which result in low observed emissivities from cold, dry snow. In the case of wet snow, the microwave emissivities are increased considerably, in agreement with earlier experimental observations in which the brightness temperatures have increased significantly at the onset of melting. Author

**N76-16597\*** Wisconsin, Univ., Madison. Dept. of Meteorology.

### THE EVALUATION OF A SHUTTLE BORNE LIDAR EXPERIMENT TO MEASURE THE GLOBAL DISTRIBUTION OF AEROSOLS AND THEIR EFFECT ON THE ATMOSPHERIC HEAT BUDGET Final Report

S. T. Shipley, J. H. Joseph, J. T. Trauger, P. J. Guetter, E. W. Eloranta, J. E. Lawler, W. J. Wiscombe, A. P. Odell, F. L. Roesler, and J. A. Weinman Apr. 1975 157 p refs (Grant NSG-1057)

(NASA-CR-146134). Avail: NTIS HC \$6.75 CSCL 04A

A shuttle-borne lidar system is described, which will provide basic data about aerosol distributions for developing climatological models. Topics discussed include: (1) present knowledge of the physical characteristics of desert aerosols and the absorption characteristics of atmospheric gas, (2) radiative heating computations, and (3) general circulation models. The characteristics of a shuttle-borne radar are presented along with some laboratory studies which identify schemes that permit the implementation of a high spectral resolution lidar system. Author

**N76-16609#** Federal Energy Administration, Washington, D.C. Office of Coal.

### PROJECT PROPOSAL FOR SURFACE-MINED LAND ENHANCEMENT (SMILE)

Arthur M. Hughes and David R. Maneval (Appalachian Regional Comm.) 29 Jan. 1975 71 p refs (PB-245567/3; FEA/G-75/586) Avail: NTIS HC \$4.50 CSCL 08I

A program is outlined to reclaim 6,000 acres of the worst strip-mined land on public property in 5 states: Pennsylvania, Ohio, Maryland, Kentucky, and Alabama. The five basic goals of the project are: restore public lands which have been surface mined; demonstrate that surface-mined land can be restored in ways that preserve or enhance the environment; provide immediate employment; improve secondary employment opportunities and long-term economic prospects of reclaimed areas through construction of such land-utilization features as public forests, grazing lands, farm lands, parks, recreation and tourism opportunities; make possible improvements in national coal production. GRA

**N76-17456\*** Science Applications, Inc., La Jolla, Calif.

### DETERMINATION OF AEROSOL CONTENT IN THE ATMOSPHERE FROM LANDSAT DATA Progress Report, 1 Nov. 1975 - 31 Jan. 1976

M. Griggs, Principal Investigator 1 Feb. 1976 20 p ERTS (Contract NAS5-20899)

(E76-10147; NASA-CR-146156; SAI-76-518-LJ; PR-4). Avail: NTIS HC \$3.50 CSCL 04B

**N76-17457\*** Ohio Dept. of Economic and Community Development, Columbus.

### DEVELOPMENT OF A MULTI-DISCIPLINARY ERTS USER PROGRAM IN THE STATE OF OHIO Quarterly Progress Report

Paul E. Baldrige, Principal Investigator 10 Dec. 1975 4 p ERTS

(Contract NAS5-22399)

(E76-10148; NASA-CR-146157; QPR-2). Avail: NTIS HC \$3.50 CSCL 05B

**N76-17461\*** Environmental Research Inst. of Michigan, Ann Arbor. Infrared and Optics Div.

### ANALYSIS OF RECREATIONAL LAND USING SKYLAB DATA Final Report, 7 May 1973 - 15 Sep. 1975

I. J. Sattinger, Principal Investigator, F. G. Sadowski, and N. E. G. Roller Jan. 1976 80 p refs Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 EREP

(Contract NAS9-13283)

(E76-10152; NASA-CR-144471; ERIM-103300-58-F) Avail: NTIS HC \$5.00 CSCL 08B

The author has identified the following significant results: S192 data collected on 5 August 1973 were processed by computer to produce a classification map of a part of the Gratiot-Saginaw State Game Area in south central Michigan. A 10-category map was prepared of an area consisting of diverse terrain types, including forests, wetlands, brush, and herbaceous vegetation. An accuracy check indicated that 54% of the pixels were correctly recognized. When these ten scene classes were consolidated to a 5-category map, the accuracy increased to 72%. S190 A, S190 B, and S192 data can be used for regional surveys of existing and potential recreation sites, for delineation of open space, and for preliminary evaluation of geographically extensive sites.

**N76-17463\*** Environmental Research and Technology, Inc., Concord, Mass.

### EXPERIMENTAL EVALUATION OF ATMOSPHERIC EF-

# **EFFECTS ON RADIOMETRIC MEASUREMENTS USING THE EREP OF SKYLAB Final Report**

David T. Chang, Principal Investigator and Ronald G. Isaacs Dec. 1975 93 p refs Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 EREP (Contract NAS9-13343)

(E76-10154; NASA-CR-144500; ERT-0410-F) Avail: NTIS HC \$5.00 CSCL 20F

The author has identified the following significant results. Test sites were located near the Great Salt Lake and the Salton Sea. Calculations were performed for a set of atmospheric models corresponding to the test sites, in addition to standard models for summer and winter midlatitude atmospheres with respective integrated water vapor amount of 2.4 g/sq cm and 0.9 g/sq cm. Each atmosphere was found to contain an average amount of continental aerosol. Computations were valid for high solar elevation angles. Atmospheric attenuation quantities were computed in addition to simulated EREP S192 radiances.

**N76-17465\*#** National Space Development Agency, Tokyo (Japan).

# **THE STUDY OF MESOSCALE PHENOMENA, WINTER MONSOON CLOUDS AND SNOW AREA Final Report**

Kiyoshi Tsuchiya, Principal Investigator 25 Dec. 1975 18 p refs Sponsored by NASA and Sci. and Technol. Agency, Japan Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(E76-10156; NASA-CR-144469) Avail: NTIS HC \$3.50 CSCL 04B

The author has identified the following significant results. The clouds under a moderate winter monsoon situation taken with S190A camera reveal existence of clouds with band structure of various wavelengths. The wavelength ranges from 0.4 to 3.5 kms. There was a good relationship between the longitudinal cloud band and vertical wind shear. There was a distinct difference in size of clouds between the Japan Sea side or upwind side and the Pacific Ocean side or downwind side of the Japanese mainland. Large solid cumulus clusters have the size of 20 x 35 sq km over the Japan Sea off the coast of Hokuriku District. It was found that S190A aerial color pictures showing shadows of fair weather cumuli over the sea could be successfully used in estimating cloud height while S190A station 1 picture was more useful over the land since it could more clearly distinguish shadow from vegetation. The height of fair weather cumuli estimated from shadows agree with the lifted condensation level. It was also found that these pictures were effectively used in delineating snow cover area. S192 data, especially IR channel, were found to be effective in finding topography of nimbostratus.

**N76-17466\*#** Science Univ. of Tokyo (Japan).

# **INVESTIGATION OF ENVIRONMENTAL CHANGE PATTERN IN JAPAN Final Report**

Takakazu Maruyasu, Hiroaki Ochiai, and Takamasa Nakano, Principal Investigators 18 Dec. 1975 29 p refs Sponsored by NASA and Sci. and Technol. Agency, Japan Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(E76-10157; NASA-CR-144569) Avail: NTIS HC \$4.00 CSCL 14B

**N76-17468\*#** Michigan State Univ., East Lansing.

# **USE OF REMOTE SENSING FOR LAND USE POLICY FORMULATION Annual Progress Report, Jun. 1974 - May 1975**

Myles Boylan and Raymond D. Vlasin 13 Jan. 1976 32 p refs

(Grant NGL-23-004-083)

(NASA-CR-146399) Avail: NTIS HC \$4.00 CSCL 08B

Uses of remote sensing imagery were investigated based on exploring and evaluating the capability and reliability of all

kinds of imagery for improving decision making on issues of land use at all scales of governmental administration. Emphasis was placed on applications to solving immediate problems confronting public agencies and private organizations. Resulting applications of remote sensing use by public agencies, public organizations, and related private corporations are described.

Author

**N76-17477\*** Canadian Forestry Service, Victoria (British Columbia). Pacific Forest Research Centre.

# **ARE CLEAR-CUT AREAS ESTIMATED FROM LANDSAT IMAGERY RELIABLE?**

Y. Jim Lee /In NASA. Lyndon B. Johnson Space Center. NASA Earth Resources Survey Symp. Vol. 1-A: Agr., Environment Jun. 1975 p 105-114 refs

(A-8) CSCL 08B

The reliability of LANDSAT imagery for estimation of clear-cut areas was evaluated by comparison with data obtained from high-altitude photos and logging historical map and from field inspections. A mature forest was selected as a test site because of its continuous clear-cut operation. The forest is about 50 km northwest of Victoria, British Columbia, Canada, and consists of 9092 ha. Areas clear-cut within the past year were overestimated by 12.9%, those clear-cut 1-year or more by 2.2%, whereas uncut mature timber was underestimated by 3.6%. Three clear-cut areas were missed in the logging map and two in the LANDSAT enhancement. The difference between area estimates was significant when all 26 areas were included but not when 2 overestimated areas were excluded from the analysis. The study indicates that LANDSAT imagery color enhancement is a useful tool in up-dating clear-cut areas for long-term planning in forest management.

Author

**N76-17490\*** Texas Univ. Health Science Center, Houston. School of Public Health.

# **PREDICTION OF HEALTH LEVELS BY REMOTE SENSING**

Marjorie Rush and Sally Vernon /In NASA. Lyndon B. Johnson Space Center. NASA Earth Resources Survey Symp. Vol. 1-A: Agr., Environment Jun. 1975 p 301-308 refs

(E-4) CSCL 06I

Measures of the environment derived from remote sensing were compared to census population/housing measures in their ability to discriminate among health status areas in two urban communities. Three hypotheses were developed to explore the relationships between environmental and health data. Univariate and multiple step-wise linear regression analyses were performed on data from two sample areas in Houston and Galveston, Texas. Environmental data gathered by remote sensing were found to equal or surpass census data in predicting rates of health outcomes. Remote sensing offers the advantages of data collection for any chosen area or time interval, flexibilities not allowed by the decennial census.

Author

**N76-17491\*** Earth Satellite Corp., Washington, D.C.

# **APPLICATION OF EREP, LANDSAT, AND AIRCRAFT IMAGE DATA TO ENVIRONMENTAL PROBLEMS RELATED TO COAL MINING**

Roger V. Amato, Orville R. Russell, Kenneth R. Martin, and Charles E. Wier (Indiana Geol. Survey, Bloomington) /In NASA. Lyndon B. Johnson Space Center. NASA Earth Resources Survey Symp. Vol. 1-A: Agr., Environment Jun. 1975 p 309-327 refs

(E-6) CSCL 08I

Remote sensing techniques were used to study coal mining sites within the Eastern Interior Coal Basin (Indiana, Illinois, and western Kentucky), the Appalachian Coal Basin (Ohio, West Virginia, and Pennsylvania) and the anthracite coal basins of northeastern Pennsylvania. Remote sensor data evaluated during these studies were acquired by LANDSAT, Skylab and both high and low altitude aircraft. Airborne sensors included multispectral scanners, multiband cameras and standard mapping cameras loaded with panchromatic, color and color infrared films. The research conducted in these areas is a useful prerequisite to

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the development of an operational monitoring system that can be periodically employed to supply state and federal regulatory agencies with supportive data. Further research, however, must be undertaken to systematically examine those mining processes and features that can be monitored cost effectively using remote sensors and for determining what combination of sensors and ground sampling processes provide the optimum combination for an operational system. Author

**N76-17494\*** Virginia State Water Control Board, Richmond. Div. of Surveillance and Field Studies.

### **LANDSAT-1 DATA AS IT HAS BEEN APPLIED FOR LAND USE AND WATER QUALITY DATA BY THE VIRGINIA STATE WATER CONTROL BOARD. 1: THE STATE PROJECT. 2: MONITORING WATER QUALITY FROM LANDSAT**

Peter L. Trexler and John L. Barker (NASA. Goddard Space Flight Center) *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Survey Symp. Vol. 1-A: Agr., Environment Jun. 1975 p 371-418 refs

(E-10) CSCL 08H

LANDSAT-1 imagery has been used for water quality and land use monitoring in and around the Swift Creek and Lake Chesdin Reservoirs in Virginia. This has proved useful by (1) helping determine valid reservoir sampling stations, (2) monitoring areas not accessible by land or water, (3) giving the State a viable means of measuring Secchi depth readings in these inaccessible areas, (4) giving an overview of trends in changing sedimentation loadings over a given time period and classifying these waters into various categories, (5) enabling the State to inventory all major lakes and reservoirs and computing their acreage, (6) monitoring land use changes in any specific area, (7) evaluating possible long-term environmental effects of nearby developments, and (8) monitoring and predicting population shifts with possible impact on water quality problems. The main problems in the long-term use of such imagery appear to be cost and lack of consistency due to cloud cover limitations. Author

**N76-17498\*** American Univ., Washington, D.C. Dept. of Biology.

### **COMPARATIVE UTILITY OF LANDSAT-1 AND SKYLAB DATA FOR COASTAL WETLAND MAPPING AND ECOLOGICAL STUDIES**

Richard Anderson, Linda Alsid, and Virginia Carter (US Geol. Survey, Reston, Va.) *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Survey Symp. Vol. 1-A: Agr., Environment Jun. 1975 p 469-477 refs

(E-14) CSCL 08B

SkyLab 190-A photography and LANDSAT-1 analog data have been analyzed to determine coastal wetland mapping potential as a near term substitute for aircraft data and as a long term monitoring tool. The level of detail and accuracy of each was compared. SkyLab data provides more accurate classification of wetland types, better delineation of freshwater marshes and more detailed analysis of drainage patterns. LANDSAT-1 analog data is useful for general classification, boundary definition and monitoring of human impact in wetlands. Author

### **N76-17500\*** Earth Satellite Corp., Berkeley, Calif. **A COMPARATIVE INTERREGIONAL ANALYSIS OF SELECTED DATA FROM LANDSAT-1 AND EREP FOR THE INVENTORY AND MONITORING OF NATURAL ECOSYSTEMS**

Charles E. Poulton *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Survey Symp. Vol. 1-A: Agr., Environment Jun. 1975 p 507-598 refs

(E-16) CSCL 08F

Comparative statistics were presented on the capability of LANDSAT-1 and three of the SkyLab remote sensing systems (S-190A, S-190B, S-192) for the recognition and inventory of

analogous natural vegetations and landscape features important in resource allocation and management. Two analogous regions presenting vegetational zonation from salt desert to alpine conditions above the timberline were observed, emphasizing the visual interpretation mode in the investigation. An hierarchical legend system was used as the basic classification of all land surface features. Comparative tests were run on image identifiability with the different sensor systems, and mapping and interpretation tests were made both in monocular and stereo interpretation with all systems except the S-192. Significant advantage was found in the use of stereo from space when image analysis is by visual or visual-machine-aided interactive systems. Some cost factors in mapping from space are identified. The various image types are compared and an operational system is postulated. Author

**N76-17512\*** D'Appolonia (E.) Consulting Engineers, Inc., Pittsburgh, Pa.

### **THE UTILIZATION OF LANDSAT IMAGERY IN NUCLEAR POWER PLANT SITING**

A. J. Eggenberger, D. Rowlands, and P. C. Rizzo *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Survey Symp., Vol. 1-B Jun. 1975 p 799-832 refs

(G-14) CSCL 08B

LANDSAT imagery was used primarily to map geologic features such as lineaments, linears, faults, and other major geologic structures which affect site selection for a nuclear power plant. Areas studied include Pakistan, the South Carolina Piedmont, and Huelva, Spain. Author

**N76-17514\*** Laboratori della Geofisica della Litosfera, Milan (Italy).

### **APPLICATION OF SKYLAB IMAGERY TO SOME GEOLOGICAL AND ENVIRONMENTAL PROBLEMS IN ITALY**

R. Cassinis, G. M. Lechi, and A. M. Tonelli *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Survey Symp., Vol. 1-B Jun. 1975 p 851-867 refs

(G-16) CSCL 08G

Four topics are considered: regional geology of Sicily, volcanic surveillance in southern Italy, hydrogeology (with special regard given to the discovery and mapping of paleoriverbeds), and crop investigation. The discovery of unknown lineaments and structures in Sicily contributes to the geological knowledge of this region and in particular to the mechanical phenomena involving the upper part of the crust. An attempt was made to relate the status of vegetation surrounding Etna volcano to the magmatic gas escapes filtering through the soil. False-color SkyLab images were used to analyze the vigor of the Etnean forestal belt vegetation canopy in order to map possible gas-vent ways as well as the 'active' microfractures. In northern Italy, buried channels, were mapped in the Venetian Plain, and a tentative cost-benefit evaluation was done in the field of vegetational studies, both disease detection and species inventory were performed in the Po River Delta and in northwestern Italy. Author

**N76-17522\*** Texas Univ., Austin. Bureau of Economic Geology.

### **REGIONAL INVENTORIES AND MAPPING OF LAND RESOURCES AND ENVIRONMENTAL GEOLOGY USING REMOTELY SENSED DATA**

E. G. Wermund, L. F. Brown, Jr., and W. L. Fisher *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Survey Symp., Vol. 1-B Jun. 1975 p 1029-1057 refs

CSCL 08B

Black-and-white stereoscopic aerial photographs at a scale of 1:20,000, 1:40,000, and 1:65,000 and controlled aerial photo mosaics at a scale of 1:24,000 were the basic data utilized for most mapping. Color and color infrared aerial photography (1:20,000) was employed to map the barrier islands, and color infrared photography (1:120,000) was used to map sand and

mud units of the coastal plain north of Houston. LANDSAT-1 imagery in Bands 4, 5, and 7 (1:250,000) was utilized to examine land use and certain resource units statewide. Side scanning radar and LANDSAT imagery were studied experimentally toward mapping land suitability units in carbonate terranes with high relief and certain other terranes. Large-scale color and color infrared aerial stereoscopic photographs supply the most information for regional mapping. black-and-white photography is the most practical data for mapping because of scale, complete coverage, availability, and relatively low cost. Author

**N76-17528\*** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.  
**THE SKYLAB CONCENTRATED ATMOSPHERIC RADIATION PROJECT**

Peter M. Kuhn (NOAA, Boulder, Colo.), Victor S. Whitehead, and William E. Marlatt (Colo. State Univ.) *In its* NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 1177-1184 refs

(I-4) CSCL 04A

The Skylab field phase in June, August and September of 1973 for the Skylab concentrated atmospheric radiation project provided an opportunity to conduct infrared and solar observations and subsequent calculations beneath the orbiting space vehicle during EREP overpasses. Infrared and solar transmission and absorption properties observed within the atmosphere were compared with EREP experiments, notably the S-191 and S-192. These same observations were later employed in the development and comparison of various atmospheric infrared and solar radiative transfer approximations. Solar radiation observations and calculations in the scattering atmosphere included the 0.4 to 1.1 microns spectral range while infrared observations and calculations covered the spectral band and portions thereof within the 5.0 to 40.0 microns region. Principal conclusions drawn from the solar radiation research and the infrared radiation research are discussed. Author

**N76-17532\*** Nebraska Univ., Lincoln. Coll. of Engineering and Technology.

**GROUND ZERO AND UP; NEBRASKA'S RESOURCES AND LAND USE**

Donald M. Edwards and Roger Macklem (Nebr. State Dept. of Educ.) *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 1225-1236 ref

(I-8) CSCL 05I

A one-semester high school course was developed about the use of remote sensing techniques for land earth resources planning and management. The slide-tape-workbook program was field tested with high school students to show a substantial increase in gain of knowledge and an attitude change in application of remote sensing techniques. Author

**N76-17552\*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

**NASA EARTH RESOURCES SURVEY SYMPOSIUM. VOLUME 1-C: LAND USE, MARINE RESOURCES First Comprehensive Symposium on the Practical Application of Earth Resources Survey Data**

Jun. 1975 675 p refs Symp. held at Houston, Tex., 9-12 Jun. 1975 See also Vol. 1-A N76-17469; Vol. 1-B N76-17501; Vol. 1-D N76-17588; Vol. 3 N76-17613; Original contains color imagery. Original NASA photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198

(NASA-TM-X-58168-Vol-1-C; JSC-09930-Vol-1-C) Avail: NTIS HC \$7.25 CSCL 05B

Articles are presented on the utilization of remote sensing data from NASA programs involving LANDSAT, the Skylab Earth resources experiment package, and aircraft, as well as from other data acquisition programs. Emphasis is placed on land use and marine resources.

**N76-17553\*** South Dakota State Planning Agency, Pierre.  
**THE SOUTH DAKOTA COOPERATIVE LAND USE EFFORT: A STATE LEVEL REMOTE SENSING DEMONSTRATION PROJECT**

Paul A. Tessar, Dennis R. Hood (Geological Survey, Sioux Falls, S. D.), and William J. Todd (Technicolor Graphic Services, Inc., Sioux Falls, S. D.) *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975 p 1499-1523 refs

(L-1) CSCL 08B

Remote sensing technology can satisfy or make significant contributions toward satisfying many of the information needs of governmental natural resource planners and policy makers. Recognizing this potential, the South Dakota State Planning Bureau and the EROS Data Center together formulated the framework for an ongoing Land Use and Natural Resource Inventory and Information System Program. Statewide land use/land cover information is generated from LANDSAT digital data and high altitude photography. Many applications of the system are anticipated as it evolves and data are added from more conventional sources. The conceptualization, design, and implementation of the program are discussed. Author

**N76-17555\*** Ohio Dept. of Economic and Community Development, Columbus.

**OHIO'S STATEWIDE LAND USE INVENTORY: AN OPERATIONAL APPROACH FOR APPLYING LANDSAT DATA TO STATE, REGIONAL AND LOCAL PLANNING PROGRAMS**

Paul E. Baldridge, Paul H. Geosling, Frank Leone, Charles Minshall (Battelle Columbus Labs.), Robert H. Rodgers (Bendix Aerospace Corp., Ann Arbor, Mich.), and Carl L. Wilhelm (Ohio EPA) *In* NASA. Lyndon B. Johnson Space Center, NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975 p 1541-1552 refs

(L-3) CSCL 08F

The programmatic, technical, user application, and cost factors associated with the development of an operational, statewide land use inventory from LANDSAT data are described. The LANDSAT multispectral data are subjected to geometrical and categorical processing to produce map files for each of the 200 fifteen (15) minute quads covering Ohio. Computer compatible tapes are rescanned to produce inventory tapes which identify eight (8) Level I land use categories and a variety of Level II categories. The inventory tapes are processed through a series of ten (10) software programs developed by the State of Ohio. The net result is a computerized inventory which can be displayed in map or tabular form for various geographic units, at a variety of scales and for selected categories of usage. The computerized inventory data files are applied to technical programs developed by the various state agencies to be used in state, regional, and local planning programs. Author

**N76-17556\*** Geological Survey, Phoenix, Ariz.

**ARIZONA LAND USE EXPERIMENT**

Carl C. Winikka and Herbert H. Schumann *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975 p 1553-1572 refs

(L-4) CSCL 08B

Utilization of new sources of statewide remote sensing data, taken from high-altitude aircraft and from spacecraft is discussed along with incorporation of information extracted from these sources into on-going land and resources management programs in Arizona. Statewide cartographic applications of remote sensor data taken by NASA high-altitude aircraft include the development of a statewide semi-analytic control network, the production of nearly 1900 orthophotoquads (image maps) that are coincident in scale and area with the U.S. Geological Survey (USGS) 7.5 minute topographic quadrangle map series, and satellite image maps of Arizona produced from LANDSAT multispectral scanner imagery. These cartographic products are utilized for a wide variety of experimental and operational earth resources applications. Applications of the imagery, image maps, and derived information discussed include: soils and geologic mapping projects, water resources investigations, land use inventories,

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environmental impact studies, highway route locations and mapping, vegetation cover mapping, wildlife habitat studies, power plant siting studies, statewide delineation of irrigation cropland, position determination of drilling sites, pictorial geographic bases for thematic mapping, and court exhibits. Author

**N76-17557\*** Cornell Univ., Ithaca, N.Y.  
**THE DESIGN, IMPLEMENTATION, AND USE OF A STATEWIDE LAND USE INVENTORY: THE NEW YORK EXPERIENCE**

Ernest E. Hardy *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975 p 1573-1602

(L-5) CSCL 08B

The New York State land use and natural resource inventory is described with emphasis on its design, implementation, and user requirements. Other topics discussed include: classification, data acquisition, geographic referencing, data storage, data retrieval, and documentation. J.M.S.

**N76-17558\*** Alaska Univ., Fairbanks.  
**ALASKAN RESOURCES, CURRENT DEVELOPMENT, TRADITIONAL CULTURAL VALUES, AND THE ROLE OF LANDSAT DATA IN CURRENT AND FUTURE LAND USE MANAGEMENT PLANNING**

Arthur LaPerriere *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975 p 1603-1608 refs

(L-6) CSCL 08F

Past, present, and proposed applications of LANDSAT data for renewable resource assessments in Alaska are described. Specific projects briefly discussed include: a feasibility investigation applying LANDSAT data to caribou habitat mapping in northeast Alaska, analysis of a native corporate region in southwest Alaska, analysis of a game management unit in interior Alaska, and two proposed analyses in northwest Alaska. These analyses principally address range evaluations concerning caribou, moose, and Dall sheep, but results have application to other renewable resource themes. Application of resource assessment results to a statewide land use management plan is discussed. Author

**N76-17559\*** Geological Survey, Reston, Va.  
**THE NATIONAL LAND USE DATA PROGRAM OF THE US GEOLOGICAL SURVEY**

James R. Anderson and Richard E. Witmer *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975 p 1609-1615 refs

(L-7) CSCL 08B

The Land Use Data and Analysis (LUDA) Program which provides a systematic and comprehensive collection and analysis of land use and land cover data on a nationwide basis is described. Maps are compiled at about 1:125,000 scale showing present land use/cover at Level II of a land use/cover classification system developed by the U.S. Geological Survey in conjunction with other Federal and state agencies and other users. For each of the land use/cover maps produced at 1:125,000 scale, overlays are also compiled showing Federal land ownership, river basins and subbasins, counties, and census county subdivisions. The program utilizes the advanced technology of the Special Mapping Center of the U.S. Geological Survey, high altitude NASA photographs, aerial photographs acquired for the USGS Topographic Division's mapping program, and LANDSAT data in complementary ways. Author

**N76-17561\*** Ohio-Kentucky-Indiana Regional Council of Governments, Cincinnati.

**THE DEVELOPMENT OF A LAND USE INVENTORY FOR REGIONAL PLANNING USING SATELLITE IMAGERY**

A. H. Hessling and Timothy G. Mara *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975 p 1631-1636 refs

(L-10) CSCL 05A

Water quality planning in Ohio, Kentucky, and Indiana is reviewed in terms of use of land use data and satellite imagery. A land use inventory applicable to water quality planning and developed through computer processing of LANDSAT-1 imagery is described. J.M.S.

**N76-17562\*** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.  
**LUMIS: A LAND USE MANAGEMENT INFORMATION SYSTEM FOR URBAN PLANNING**

Charles K. Paul *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975 p 1637-1664 refs  
(L-11) CSCL 05B

The Land Use Management Information System (LUMIS) consists of a methodology of compiling land use maps by means of air photo interpretation techniques, digitizing these and other maps into machine-readable form, and numerically overlaying these various maps in two computer software routines to provide land use and natural resource data files referenced to the individual census block. The two computer routines are the Polygon Intersection Overlay System (PIOS) and an interactive graphics APL program. A block referenced file of land use, natural resources, geology, elevation, slope, and fault-line items has been created and supplied to the Los Angeles Department of City Planning for the City's portion of the Santa Monica Mountains. In addition, the interactive system contains one hundred and seventy-three socio-economic data items created by merging the Third Count U.S. Census Bureau tapes and the Los Angeles County Secured Assessor File. This data can be graphically displayed for each and every block, block group, or tract for six test tracts in Woodland Hills, California. Other benefits of LUMIS are the knowledge of air photo availability, flight pattern coverage and frequencies, and private photogrammetry companies flying Southern California, as well as a formal Delphi study of relevant land use informational needs in the Santa Monicas. Author

**N76-17563\*** National Aeronautics and Space Administration.  
John F. Kennedy Space Center, Cocoa Beach, Fla.

**SATELLITE INFORMATION ON ORLANDO, FLORIDA**

John W. Hannah (Brevard County Planning Dept., Fla.), Garland L. Thomas (Brevard County Planning Dept., Fla.), and Fernando Esparza *In* NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975 p 1665-1682 ref

(L-13) CSCL 05B

A land use map of Orange County, Florida was prepared from EREP photography while LANDSAT and EREP multispectral scanner data were used to provide more detailed information on Orlando and its suburbs. The generalized maps were prepared by tracing the patterns on an overlay, using an enlarging viewer. Digital analysis of the multispectral scanner data was basically the maximum likelihood classification method with training sample input and computer printer mapping of the results. Urban features delineated by the maps are discussed. It is concluded that computer classification, accompanied by human interpretation and manual simplification can produce land use maps which are useful on a regional, county, and city basis. Author

**N76-17564\*** Geological Survey, Reston, Va.  
**LAND USE AND ENVIRONMENTAL ASSESSMENT IN THE CENTRAL ATLANTIC REGION**

Robert H. Alexander, Katherine Fitzpatrick, Harry F. Lins, Jr., and Herbert K. McGinty, III *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975 p 1683-1727 refs

(L-14) CSCL 08F

Data from high altitude aircraft, LANDSAT and Skylab were used in a comprehensive regional survey of land use and its associated environmental impact in the Central Atlantic Regional Ecological Test Site (CARETS). Each sensor system has advantages that were demonstrated by producing experimental land use maps and other data products, applying them to typical problems encountered in regional planning and environmental impact assessment, and presenting the results to prospective users for evaluation. An archival collection of imagery, maps, data

summaries, and technical reports was assembled, constituting an environmental profile of the central Atlantic region. The investigation was organized into four closely-related modules, a land use information module, an environmental impact module, a user interaction and evaluation module, and a geographic information systems module. Results revealed a heterogeneous user community with diverse information needs, tending, however, definitely toward the higher-resolution sensor data and the larger-scale land use maps and related information products. Among project recommendations are greater efforts toward improving compatibility of federal, state, and local land use information programs, and greater efforts toward a broader exchange of imagery, computer tapes, and land use information derived therefrom. Author

**N76-17565\*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

**REMOTE SENSING IMPACT ON CORRIDOR SELECTION AND PLACEMENT**

F. J. Thomson. (Environmental Res. Inst. of Michigan, Ann Arbor) and A. N. Sellman. *In its NASA Earth Resources Surv. Symp.*, Vol. 1-C Jun. 1975 p.1729-1745 refs

(L-15) CSCL 08B

Computer-aided corridor selection techniques, utilizing digitized data bases of socio-economic, census, and cadastral data, and developed for highway corridor routing are considered. Land resource data generated from various remote sensing data sources were successfully merged with the ancillary data files of a corridor selection model and prototype highway corridors were designed using the combined data set. Remote sensing derived information considered useful for highway corridor location, special considerations in geometric correction of remote sensing data to facilitate merging it with ancillary data files, and special interface requirements are briefly discussed. Author

**N76-17568\*** Alaska Univ., Fairbanks.

**APPLICATION OF SATELLITE REMOTE-SENSING DATA TO LAND SELECTION AND MANAGEMENT**

W. J. Stringer, J. M. Miller, A. E. Belon, L. H. Shapiro, and J. H. Anderson. *In NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp.*, Vol. 1-C Jun. 1975 p.1785-1795 refs Sponsored in part by Dept. of Interior

(Grant NGL-02-001-092)

(L-18) CSCL 05A

A pilot project conducted to demonstrate the utility and economy of satellite data in preparing thematic maps of a wilderness area emphasizing those resources of greatest interest to the potential owner is described. Vegetation maps delineating potential commercial timber and maps of suggested mineral prospecting areas of seven scattered regions were prepared by interpretation of LANDSAT images, coupled with a limited amount of ground truth. Images acquired both in winter and summer seasons were registered to township maps and used in making interpretations of the areal extent of commercial timber potentials. The amount of snow cover visible through the forest canopies was found to be a useful indicator of timber potentials. Identification was made of characteristic topographic features which are typical of flood plain deposits or of the well developed trellis drainage patterns which can indicate the strike of structural grain of underlying Cretaceous sedimentary rocks. The presence of igneous and mixed igneous and metamorphic rocks were indicated by combinations of spectral differences and anomalous interruptions of local radial drainage patterns. Author

**N76-17571\*** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

**PRESENT AND POTENTIAL LAND USE MAPPING IN MEXICO**

Hector Garduno, Ricardo Garcia Lagos, and Fernando Garcia Simo. *In its NASA Earth Resources Surv. Symp.*, Vol. 1-C Jun. 1975 p.1823-1839 refs

(L-22) CSCL 08B

The Mexican Water Plan (MWP) conducted studies of present and potential land use in Mexico using LANDSAT-1 satellite imagery. Present land use studies were carried out all over the country (197 million hectares); nine soil uses were mapped according to the first classification level recommended by the U.S. Geological Survey. Also 6.3 million hectares of land with advanced erosion were detected. Work was executed at a rate of 8 million hectares per month; reliability was 90%, and the cost of only 0.1 cents/hectare. The potential land use study was performed in 45 million hectares at a rate of 4 million hectares per month and at a cost of 0.33 cents/hectare. Soil units according to FAO classification were delineated scale 1:1 million; interpretative maps were also prepared dealing with potential agricultural productivity carrying capacity for cattle, water, erosion risk, and slope ranges. Author

**N76-17572\*** Earth Satellite Corp., Washington, D.C.

**LAND USE CLASSIFICATION IN BOLIVIA**

Carlos E. Brockman (GEOBOL, La Paz, Bolivia) and William G. Brooner. *In NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp.*, Vol. 1-C Jun. 1975 p.1841-1861 refs

(L-23) CSCL 08B

The Bolivian LANDSAT Program is an integrated, multidisciplinary project designed to provide thematic analysis of LANDSAT, Skylab, and other remotely sensed data for natural resource management and development in Bolivia, is discussed. Among the first requirements in the program is the development of a legend, and appropriate methodologies, for the analysis and classification of present land use based on landscape cover. The land use legend for Bolivia consists of approximately 80 categories in a hierarchical organization which may be collapsed for generalization, or expanded for greater detail. The categories, and their definitions, provide for both a graphic and textual description of the complex and diverse landscapes found in Bolivia, and are designed for analysis from LANDSAT and other remotely sensed data at scales of 1:1,000,000 and 1:250,000. Procedures and example products developed are described and illustrated, for the systematic analysis and mapping of present land use for all of Bolivia. Author

**N76-17573\*** Central Lab. for Geophotogrammetry and Remote Sensing, Munich (West Germany).

**APPLICATION OF LANDSAT AND SKYLAB DATA FOR LAND USE MAPPING IN ITALY**

J. Bodechtel, J. Nithack, G. DiBernardo, K. Hiller, F. Jaskolla, and A. Smolka. *In NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp.*, Vol. 1-C Jun. 1975 p.1863-1886 ref

(L-25) CSCL 08B

Utilizing LANDSAT and Skylab multispectral imagery of 1972 and 1973, a land use map of the mountainous regions of Italy was evaluated at a scale of 1:250,000. Seven level I categories were identified by conventional methods of photointerpretation. Images of multispectral scanner (MSS) bands 5 and 7, or equivalents were mainly used. Areas of less than 200 by 200 m were classified and standard procedures were established for interpretation of multispectral satellite imagery. Land use maps were produced for central and southern Europe indicating that the existing land use maps could be updated and optimized. The complexity of European land use patterns, the intensive morphology of young mountain ranges, and time-cost calculations are the reasons that the applied conventional techniques are superior to automatic evaluation. Author

**N76-17591\*** California Univ., Santa Barbara. Geography Remote Sensing Unit.

**URBAN LAND USE: REMOTE SENSING OF GROUND-BASIN PERMEABILITY**

Larry R. Tinney, John R. Jensen, and John E. Estes. *In NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp.*, Vol. 1-D Jun. 1975 p.2199-2206 refs

(W-4) CSCL 08B



## 02 ENVIRONMENTAL CHANGES AND CULTURAL RESOURCES

A remote sensing analysis of the amount and type of permeable and impermeable surfaces overlying an urban recharge basin is discussed. An effective methodology for accurately generating this data as input to a safe yield study is detailed and compared to more conventional alternative approaches. The amount of area inventoried, approximately 10 sq. miles, should provide a reliable base against which automatic pattern recognition algorithms, currently under investigation for this task, can be evaluated. If successful, such approaches can significantly reduce the time and effort involved in obtaining permeability data, an important aspect of urban hydrology dynamics. Author

**N76-17594\*** Oklahoma Univ., Norman.  
**THE CORRELATION OF SKYLAB L-BAND BRIGHTNESS TEMPERATURES WITH ANTECEDENT PRECIPITATION**  
Marshall J. McFarland In NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-D Jun. 1975 p 2243-2252 refs  
(Contract NAS9-13360; Proj. 582)  
(W-7) CSCL 08M

The S194 L-band radiometer flown on the Skylab mission measured terrestrial radiation at the microwave wavelength of 21.4 cm. The terrain emissivity at this wavelength is strongly dependent on the soil moisture content, which can be inferred from antecedent precipitation. For the Skylab data acquisition pass from the Oklahoma panhandle to southeastern Texas on 11 June 1973, the S194 brightness temperatures are highly correlated with antecedent precipitation from the preceding eleven day period, but very little correlation was apparent for the preceding five day period. The correlation coefficient between the averaged antecedent precipitation index values and the corresponding S194 brightness temperatures between 230 K and 270 K, the region of apparent response to soil moisture in the data, was -0.97. The equation of the linear least squares line fitted to the data was:  $API (cm) = 31.99 - 0.114 TB (K)$ , where API is the antecedent precipitation index and TB is the S194 brightness temperature. Author

**N76-17616\*** Oregon Dept. of Environmental Quality, Portland.  
**ENVIRONMENT**  
Ronald L. Myles In NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 3 Jun. 1975 p 15-19

CSCL 08F

Applications of remote sensing technology to wildlife preservation, pest control, strip mining, water quality monitoring, and wetlands mapping were discussed. Economic, political and social factors were also considered. D.M.L.

**N76-17619\*** Georgia Dept. of Natural Resources, Atlanta.  
**LAND USE, STATE AND LOCAL USERS**  
Charles M. Parrish, III In NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 3 Jun. 1975 p 35-38  
CSCL 08B

The state and local and land use sessions involved a cross section of the expanding community of government managers who use remotely sensed information to make programmatic decisions. Problems that can be inferred from the presentations and resulting discussion are addressed. Recommendations are also given to facilitate utilization of remote sensing technology. Author

**N76-17637#** Environmental Research Inst. of Michigan, Ann Arbor.  
**THE APPLICATION OF REMOTE SENSING TECHNOLOGY TO LOCAL ENVIRONMENTAL PLANNING AND PUBLIC POLICY FORMULATION** Final Summary Report. Jun. 1972 - Nov. 1974  
R. Keith Raney Jun. 1975 62 p refs  
(Grant NSF GI-34809)

(PB-245619/2; ERIM-193500-6-F; NSF/RA/E-75/035) Avail: NTIS HC \$4.50 CSCL 13B

Use of the technology of remote sensing information systems included: (1) Determination of the present sources, content, and flow of information within and between selected agencies, (2) introduction of remotely sensed information into these agencies, and (3) assessment of the actual and likely future impact of such information on public decisions effected by the agencies. GRA

**N76-17638#** Environmental Research Inst. of Michigan, Ann Arbor.  
**THE PROSPECTS FOR IMPROVING HIGHWAY PLANNING THROUGH REMOTE SENSING INFORMATION SYSTEMS: A CASE STUDY FOR MICHIGAN** Final Report. Jun. 1972 - Nov. 1974

A. N. Sellman and K. P. Warner Jul. 1975 90 p refs  
(Grant NSF GI-34809)  
(PB-245621/8; ERIM-193500-6-F2) Avail: NTIS HC \$5.00 CSCL 13B

This volume is the final report of a three year study funded by the National Science Foundation to identify and measure the impact of remote sensing on highway planning objectives. During that time the Environmental Research Institute of Michigan (ERIM) maintained a cooperative research program with the Michigan Department of State Highways and Transportation (MDSHT) to focus on three major issues facing highway planners today: (1) the traditional problem of coordinating many divisions to achieve an integrated planning goal, (2) the institutional and programmatic reorganization engendered by the Action Plan guidelines of the Federal Highway Administration, and (3) the capacity of contemporary remote-sensing technologies to supply environmental information required for highway planning as practiced today. GRA

**N76-17656\*** National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.  
**STACK PLUME VISUALIZATION SYSTEM** Patent  
Reginald J. Exton, inventor (to NASA) Issued 6 Jan. 1976 6 p Filed 11 Mar. 1975 Supersedes N75-20091 (13 - 11, p 1308)  
(NASA-Case-LAR-11675-1; US-Patent-3,931,462; US-Patent-Appl-SN-557448; US-Patent-Class-178-6.8; US-Patent-Class-178-DIG.1; US-Patent-Class-178-DIG.8; US-Patent-Class-250-373; US-Patent-Class-340-237S; US-Patent-Class-356-207) Avail: US Patent Office CSCL 13B

A method and apparatus for measuring, at a remote location, the concentration and velocity of SO<sub>2</sub> in plume from a smokestack are described. An ultraviolet video system views the plume against the background sky at wavelengths where SO<sub>2</sub> molecules absorb light. The result is a real time display of the plume coupled with means for measuring the SO<sub>2</sub> concentration at any point in the plume and at any time desired. In addition, means are provided in combination with the ultraviolet video system for measuring the velocity of the SO<sub>2</sub> in the plume. Official Gazette of the U.S. Patent Office

**N76-17755#** World Meteorological Organization, Geneva (Switzerland).  
**REPORT ON THE FIELD PHASE OF THE GARP ATLANTIC TROPICAL EXPERIMENT: SUMMARY OF DATA COLLECTED**

T. C. DeLaMoriniere and D. J. Bates Apr. 1975 231 p Prepared jointly with Intern. Council of Sci. Unions  
(GATE-19) Avail: NTIS HC \$8.00; WMO, Geneva

Information on the types of measurements made by each data collection platform (including ships, buoys and meteorological satellites) and land station is given and the resulting amount of data for each type of measurement from each platform and station is estimated.

**N76-17756** World Meteorological Organization, Geneva (Switzerland).

**SHIP DATA COLLECTION**

*In its Rept. on the Field Phase of the GARP Atlantic Trop.*  
Expt.: Sum. of Data Collected Apr. 1975 p 6-132

A description of GATE ship data collection is given in terms of the amounts and time/space distribution for the various measurements. A summary of the measurements made is presented, followed by the amounts of data collected given as totals by type of measurement for each operational phase and participating ship. Detailed information on upper air and radar observations is also given together with a summary of the various ship intercomparison measurements. ESA

**N76-17757** World Meteorological Organization, Geneva (Switzerland).

**BUOY DATA COLLECTION**

*In its Rept. on the Field Phase of the GARP Atlantic Trop.*  
Expt.: Sum. of Data Collected Apr. 1975 p 134-160

A summary of the instrumentation employed on each type of buoy used during GATE is given followed by diagrams and tables summarizing the location, operational periods and data collected for each individual buoy. Oceanographic buoys are dealt with separately from those having mainly meteorological instruments. ESA

**N76-17758** World Meteorological Organization, Geneva (Switzerland).

**SATELLITE DATA COLLECTION**

*In its Rept. on the Field Phase of the GARP Atlantic Trop.*  
Expt.: Sum. of Data Collected Apr. 1975 p 162-182

The satellite data collection effort for GATE is summarized for each satellite taking part. Included are ATS 3, SMS 1, Nimbus 5, Meteor 13, 16, 17, 18, ESSA 8, and NOAA 2 and 3. The various magnetic tape and photographic products expected from each satellite along with indications of the amount of data collected and the periods of collection are also given. ESA

**N76-17773\*** Linguistic Systems, Inc., Cambridge, Mass.

**EMISSION FROM A DISTURBED SEA SURFACE IN THE CENTIMETER RANGE**

L. M. Martsinkevich and V. V. Melentyev Washington NASA Feb. 1976 20 p refs Transl. into ENGLISH from Tr. Glav. Geofiz. Observ. (Leningrad), no. 291, 1972 p 24-33 (Contract NASw-2482)

(NASA-TT-F-16719) Avail: NTIS HC \$3.50 CSCL 08J

An analytic expression is formulated for the fluxes of radio emission from a disturbed sea surface and from a real atmosphere in different wavelengths in the microwave region received by a radiometric detector located at a given altitude. Taken into account is the distribution of the slopes obtained in Martsinkevich, the choice of the basic parameters, and the elaboration of a computational scheme. Author

**N76-18577** Colorado State Univ., Fort Collins.

**REMOTE SENSING OF SELECTED BIOLOGICAL PHENOMENA IN LODGEPOLE PINE Ph.D. Thesis**

John Raymond Daugherty 1975 89 p  
Avail: Univ. Microfilms Order No. 76-4306

Samples of transpiration rate (TR), moisture stress level (MSL), crown surface temperature, crown air temperature, relative humidity, phenological date, ambient air temperature, and sunset were measured in the lodgepole pine forest of the Little South Fork Experimental Watershed. The purpose was to establish patterns of TR and MSL in relation to variation of the other parameters and to develop models to predict TR and total water loss amounts and MSL over a given period of the summer in the sample trees utilizing a variety of combinations of the other parameters. Data analysis show that crown surface temperature is more highly correlated with TR and MSL than was crown air temperature in a previous study. A set of equations for prediction of TR and MSL was produced allowing all the variables into the calculations. Dissert. Abstr.

**N76-18580\*** Geological Survey, Miami, Fla.

**THE APPLICATION OF LANDSAT DATA FROM COLLECTION PLATFORMS AND LANDSAT IMAGERY FOR FIRE MANAGEMENT, EVERGLADES NATIONAL PARK, FLORIDA Progress Report**

A. L. Higer, Principal Investigator, L. J. Swayge, W. L. Bancroft, and E. H. Cordes Oct. 1975 16 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(E76-10159; NASA-CR-146363) Avail: NTIS HC \$3.50 CSCL 05B

**N76-18581\*** Earth Satellite Corp., Washington, D.C.

**STUDY OF MESOSCALE EXCHANGE PROCESSES UTILIZING LANDSAT AIR MASS CLOUD IMAGERY Interim Report, Dec. 1975 - Feb. 1976**

Earl S. Merritt and Romeo R. Sabatini, Principal Investigators Feb. 1976 8 p ERTS

(Contract NAS5-20944)

(E76-10160; NASA-CR-146364) Avail: NTIS HC \$3.50 CSCL 04B

**N76-18583\*** Iowa Geological Survey Remote Sensing Lab. **LAND CLASSIFICATION OF SOUTH-CENTRAL IOWA FROM COMPUTER ENHANCED IMAGES Progress Report, 3 Aug. - 3 Oct. 1975**

James R. Lucas, Principal Investigator, James V. Taranik (EROS Data Center, Sioux Falls, S. D.), and Frederic C. Billingsley (JPL) 3 Nov. 1975 51 p Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Contract NAS5-20832)

(E76-10162; NASA-CR-146365; Rept-3) Avail: NTIS HC \$4.50 CSCL 08B

The author has identified the following significant results. Two enhanced, false color negatives from multispectral scanner scenes, dated 15 April 1974 and 29 August 1972, were printed at a scale of 1:125,000 to form the basis for land use interpretations in the Wapello County, Iowa test site. The use of geomorphic principles proved valuable in the interpretation of the April scene to form valuable generalizations for planning purposes on soil associations, topography, alluvial valleys, and agricultural land use. The August scene was superior in providing information on urban extent, transportation networks, forest cover, and water bodies.

**N76-18590\*** Science Univ. of Tokyo (Japan).

**INVESTIGATION OF ENVIRONMENTAL CHANGE PATTERN IN JAPAN: MULTIDISCIPLINARY APPLICATION OF LANDSAT-2 DATA TO MARINE ENVIRONMENT IN CENTRAL JAPAN**

Takakazu Maruyasu, Principal Investigator and Hiroaki Ochiai (Toba Merchant Marine Coll., Toba-shi, Japan) [1976] 17 p refs Sponsored by NASA. Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(E76-10169; NASA-CR-146155) Avail: NTIS HC \$3.50 CSCL 08A

The author has identified the following significant results. The multidisciplinary application of multispectral scanner data acquired over central Japan revealed several coastal features including pollution, river effluent, shorelines, red tide, etc. Supporting data were obtained by airborne remote sensing.

**N76-18591\*** Science Univ. of Tokyo (Japan).

**INVESTIGATION OF ENVIRONMENTAL CHANGE PATTERN IN JAPAN: CLASSIFICATION OF SHORELINES Quarterly Report**

Takakazu Maruyasu and Daitaro Shoji, Principal Investigators (Maritime Safety Agency, Tokyo) 3 Feb. 1976 8 p Sponsored by NASA. Original contains imagery. Original photography may

## 02 ENVIRONMENTAL CHANGES AND CULTURAL RESOURCES

be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS (E76-10170; NASA-CR-146370) Avail: NTIS HC \$3.50 CSCL 08J

The author has identified the following significant results. It was found in the band 7 that the image density of some parts of reclaimed lands had the same density with that of the sea.

**N76-18592\*#** Science Univ. of Tokyo (Japan). **INVESTIGATION OF ENVIRONMENTAL CHANGE PATTERN IN JAPAN: INVESTIGATION OF VARIATIONS IN THE PROMINENT OCEANIC CURRENT, KUROSHIO** Quarterly Report

Takakazu Maruyasu and Daitaro Shoji, Principal Investigators (Maritime Safety Agency, Tokyo) 3 Feb. 1976 6 p Sponsored by NASA Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. ERTS (E76-10171; NASA-CR-146371) Avail: NTIS HC \$3.50 CSCL 08J

The author has identified the following significant results. In the print of MSS band 4 of Shiono Misaki and Ise taken by LANDSAT on 11 September 1975, different water masses can be recognized distinctly. At 35 miles off Shiono Misaki, a vortex pattern is found which has an ellipsoidal shape with a diameter of 30 miles and appears to rotate counterclockwise. In Ise, water masses were found spreading widely along the coast from the mouth of Ise Bay. The temperature of sea surface obtained from sea truth shows almost a uniform pattern. The distribution of surface salinity and transparency shows a distinct pattern.

**N76-18593\*#** Science Univ. of Tokyo (Japan). **INVESTIGATION OF ENVIRONMENTAL CHANGE PATTERN IN JAPAN: INVESTIGATION OF SOIL EROSION IN HOKKAIDO WHICH IS CAUSED BY THAWING OF SOIL WATER IN LATE SPRING** Quarterly Progress Report, Oct. 1975 - Jan. 1976

Takasazu Maruyasu and Shigechika Hayashi, Principal Investigators (Natl. Agricultural Experiment Station, Hokkaido, Japan) Jan. 1976 3 p Sponsored by NASA and Sci. and Technol. Agency, Japan Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS (E76-10172; NASA-CR-146372) Avail: NTIS HC \$3.50 CSCL 08M

**N76-18594\*#** Science Univ. of Tokyo (Japan). **INVESTIGATION OF ENVIRONMENTAL CHANGE PATTERN IN JAPAN: INVESTIGATION OF THE ECOLOGICAL ENVIRONMENT INDEX FROM OBSERVATION OF THE REGIONAL VEGETATION COVER AND THEIR GROWING CONDITION** Quarterly Progress Report

Takakazu Maruyasu and Iwao Wakajima, Principal Investigators (Government Forest Experiment Station, Tokyo) [1976] 2 p Sponsored by NASA ERTS (E76-10173; NASA-CR-146373) Avail: NTIS HC \$3.50 CSCL 08F

**N76-18595\*#** Science Univ. of Tokyo (Japan). **INVESTIGATION OF ENVIRONMENTAL CHANGE PATTERN IN JAPAN: A STUDY ON CHANGE DETECTION OF LAND COVER IN TOKYO DISTRICTS USING MULTI-DATES LANDSAT CCT** Quarterly Report

Takakazu Maruyasu and Shunji Murai, Principal Investigators (Tokyo Univ., Japan) 9 Jan. 1976 9 p Sponsored by NASA Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS (E76-10174; NASA-CR-146374) Avail: NTIS HC \$3.50 CSCL 08F

The author has identified the following significant results. The software program, which enables the geographically corrected

LANDSAT digital data base, was developed. The data base could provide land use planners with land cover information and the environmental change pattern. Land cover was evaluated by the color representation for ratio of three primary components, water vegetation, and nonorganic matter. Software was also developed for the change detection within multitudes LANDSAT MSS data.

**N76-18596\*#** Science Univ. of Tokyo (Japan). **INVESTIGATION OF ENVIRONMENTAL CHANGE PATTERN IN JAPAN: APPLICATION OF LANDSAT-2 DATA FOR UNDERSTANDING ENVIRONMENTAL CHANGES IN THE COASTAL AND OF SHORE ZONE** Quarterly Progress Report, Oct. - Dec. 1975

Takakazu Maruyasu and Kiyoshi Tsuchiya, Principal Investigators (National Space Development Agency, Tokyo) 31 Jan. 1976 4 p Sponsored by NASA and Sci. and Technol. Agency, Japan ERTS (E76-10175; NASA-CR-146375) Avail: NTIS HC \$3.50 CSCL 08J

**N76-18599\*#** West Virginia Dept. of Natural Resources, Charleston.

**CONTRIBUTION OF ERTS-B TO NATURAL RESOURCE PROTECTION AND RECREATIONAL DEVELOPMENT IN WEST VIRGINIA** Progress Report, 19 Jun. - 19 Dec. 1975 Ira S. Latimer, Jr., Principal Investigator 19 Jan. 1976 3 p ERTS

(E76-10178; NASA-CR-146377) Avail: NTIS HC \$3.50 CSCL 08B

**N76-18601\*#** Arkansas Univ., Fayetteville. Dept. of Geology. **LAND USE CHANGE DETECTION WITH LANDSAT-2 DATA FOR MONITORING AND PREDICTING REGIONAL WATER QUALITY DEGRADATION** Quarterly Progress Report, 28 Oct. 1975 - 27 Jan. 1976

H. C. MacDonald, Principal Investigator and K. F. Steele Feb. 1976 11 p ERTS (Contract NAS5-20810) (E76-10180; NASA-CR-146379) Avail: NTIS HC \$3.50 CSCL 08H

**N76-18608\*#** Kansas Univ., Lawrence. **THE MEASUREMENT OF THE WINDS NEAR THE OCEAN SURFACE WITH A RADIOMETER-SCATTEROMETER ON SKYLAB** Final Report, Jan. 1973 - Dec. 1975

Willard J. Pierson, Richard K. Moore, E. Paul McClain, Principal Investigators, Vincent J. Cardone, James D. Young, J. Arthur Greenwood, Catherine Greenwood, Adrian K. Fung, Robert Salfi, H. L. Chan et al 21 Jan. 1976 462 p refs Prepared in cooperation with City Univ. of New York Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 EREP

(Contract NAS9-13642) (E76-10187; NASA-CR-147487) Avail: NTIS HC \$12.00 CSCL 04B

The author has identified the following significant results. There were a total of twenty-six passes in the ZLV mode that yielded useful data. Six were in the in-track noncontiguous mode; all others were in the cross-track noncontiguous mode. The wind speed and direction, as effectively determined in a neutral atmosphere at 19.5 m above the sea surface, were found for each cell scanned by S193. It is shown how the passive microwave measurements were used both to compute the attenuation of the radar beam and to determine those cells where the backscatter measurement was suspect. Given the direction of the wind from some independent source, with the typical accuracy of measurement by available meteorological methods, a backscatter measurement at a nadir angle of 50, 43, or 32 deg can be used to compute the speed of the wind averaged over the illuminated area.

**N76-18609\*#** Kansas Univ. Center for Research, Inc., Lawrence. **A JOINT METEOROLOGICAL, OCEANOGRAPHIC, AND SENSOR EVALUATION PROGRAM FOR EXPERIMENT**

## S-192 ON SKYLAB: A THEORY OF SEA SCATTER AT LARGE INCIDENT ANGLES

W. J. Pierson (City Univ. of New York), R. K. Moore, Principal Investigators, A. K. Fung, and H. L. Chan Oct. 1975 30 p refs EREP

(Contract NAS9-13642)

(E76-10188; NASA-CR-146286; RSL-TR-254-4) Avail: NTIS HC \$4.00 CSCL 08T

## N76-18611\*# Naval Research Lab., Washington, D.C. ANALYSIS OF MICROWAVE RADIOMETRIC MEASUREMENTS FROM SKYLAB

James P. Hollinger, Principal Investigator and Robert M. Lerner Dec. 1975 102 p refs EREP

(NASA Order T-4126-B)

(E76-10190; NASA-CR-147442) Avail: NTIS HC \$5.50 CSCL 05B

## N76-18615\*# National Oceanic and Atmospheric Administration, Boulder, Colo. THE SKYLAB CONCENTRATED ATMOSPHERIC RADIATION PROJECT Final Report

P. M. Kuhn, W. E. Marlatt (Colorado State Univ., Fort Collins), and V. S. Whitehead, Principal Investigators (NASA, Lyndon B. Johnson Space Center) 1 Sep. 1975 138 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 EREP

(NASA Order T-4714-B)

(E76-10195; NASA-CR-144481) Avail: NTIS HC \$6.00 CSCL 03B

The author has identified the following significant results. Comparison of several existing infrared radiative transfer models under somewhat controlled conditions and with atmospheric observations of Skylab's S191 and S192 radiometers illustrated that the models tend to over-compute atmospheric attenuation in the window region of the atmospheric infrared spectra.

## N76-18623\*# National Academy of Sciences - National Research Council, Washington, D.C. LAND USE PLANNING Practical Applications of Space Systems

1975 65 p refs (Contract NSR-09-012-106)

(NASA-CR-146404; Paper-3) Avail: NTIS HC \$4.50; Space Applications Board, National Research Council, 2101 Constitution Avenue, N. W., Washington, D. C. 20418 CSCL 08B

The organization, objectives, and accomplishments of the panel on Land Use Planning are reported. Technology developments, and projected developments are discussed along with anticipated information requirements. The issues for users, recommended remote sensing programs, and space systems are presented. It was found that remote sensing systems are useful in future land use planning. It is recommended that a change detection system for monitoring land use and critical environmental areas be developed by 1979. F.O.S.

## N76-18635\*# Virginia Polytechnic Inst. and State Univ., Blacksburg. REMOTE SENSING APPLICATION TO LAND USE CLASSIFICATION IN A RAPIDLY CHANGING AGRICULTURAL/URBAN AREA: CITY OF VIRGINIA BEACH, VIRGINIA Ph.D. Thesis

Victor Agab Omondi Odenyo Dec. 1975 205 p refs (Contract NAS6-2388)

(NASA-CR-141408) Avail: NTIS HC \$7.75 CSCL 08B

Remote sensing data on computer-compatible tapes of LANDSAT 1 multispectral scanner imager were analyzed to generate a land use map of the City of Virginia Beach. All four bands were used in both the supervised and unsupervised approaches with the LAYSYS software system. Color IR imagery of a U-2 flight of the same area was also digitized and two sample areas were analyzed via the unsupervised approach. The

relationships between the mapped land use and the soils of the area were investigated. A land use land cover map at a scale of 1:24,000 was obtained from the supervised analysis of LANDSAT 1 data. It was concluded that machine analysis of remote sensing data to produce land use maps was feasible; that the LAYSYS software system was usable for this purpose; and that the machine analysis was capable of extracting detailed information from the relatively small scale LANDSAT data in a much shorter time without compromising accuracy. Author

## N76-18696\*# National Academy of Sciences - National Research Council, Washington, D.C. ENVIRONMENTAL QUALITY Practical Applications of Space Systems

1975 66 p refs (Contract NSR-09-012-106)

(NASA-CR-146408; Paper-7) Avail: NTIS HC \$4.50; Space Applications Board, National Research Council, 2101 Constitution Avenue, N. W., Washington, D. C. 20418 CSCL 13B

The potential use of space systems to help determine the current state of air, water, and land environments was examined; the effects of man's activities on these parameters were also examined. Data are limited to pollutants introduced into the major environmental media, environmental changes manifested by such pollutants, and the effectiveness of abatement and control methods. Data also cover land quality as related to land use and public health. E.H.W.

## N76-18697\*# Miami Univ., Coral Gables, Fla. Dept. of Mechanical Engineering. APPLICATION OF REMOTE SENSING FOR PREDICTION AND DETECTION OF THERMAL POLLUTION, PHASE 2

T. Nejat Veziroglu and Samuel S. Lee Dec. 1975 158 p refs (Contract NAS10-8740)

(NASA-CR-139188) Avail: NTIS HC \$6.75 CSCL 13B

The development of a predictive mathematical model for thermal pollution in connection with remote sensing measurements was continued. A rigid-lid model has been developed and its application to far-field study has been completed. The velocity and temperature fields have been computed for different atmospheric conditions and for different boundary currents produced by tidal effects. In connection with the theoretical work, six experimental studies of the two sites in question (Biscayne Bay site and Hutchinson Island site) have been carried out. The temperature fields obtained during the tests at the Biscayne Bay site have been compared with the predictions of the rigid-lid model and these results are encouraging. The rigid-lid model is also being applied to near-field study. Preliminary results for a simple case have been obtained and execution of more realistic cases has been initiated. The development of a free-surface model, also been initiated. The governing equations have been formulated, and the computer programs have been written. Author

## N76-18715 Colorado State Univ., Fort Collins. A TEST AND COMPARISON OF RADIATIVE TRANSFER MODELS THROUGH SCATTERING ATMOSPHERES Ph.D. Thesis

Warner Kenneth Reeser, Jr. 1975 200 p Avail: Univ. Microfilms Order No. 76-4325

The radiative transfer theory was reviewed to determine its applicability to the correction of remote sensing data monitored for atmospheric scattering effects in the solar portion of the electromagnetic spectrum. A number of approaches ranging in complexity from approximate to 'exact' solutions were selected from the literature and modified for comparison purposes using data collected during the Skylab Scarp Program. Specifically, the following models were evaluated: (1) Single scattering, (2) two stream, (3) modified two stream, (4) Eddington, (5) Turner, and (6) doubling. A comparison of the various models was performed as a function of data input, target albedo, meteorological air mass present, and wavelength. Multiple scattering models are shown to give similar results using modeled data inputs. When measured optical depth values are used the more 'exact' solutions demonstrate a significant increase in accuracy. The doubling model is shown to be the best predictor of target albedo for this study. Dissert. Abstr.

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**N76-18722\*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.  
**GRAVITY ANOMALY DETECTION: APOLLO/SOYUZ**  
F. O. Vonbun, W. D. Kahn, J. W. Bryan, P. E. Schmid, W. T. Wells (Wolf Res. and Develop. Corp., Riverdale, Md.), and D. T. Conrad (Wolf Res. and Develop. Corp., Riverdale, Md.) 16 Mar. 1976 20 p refs Presented at conf. of Am. Geophys. Union, San Francisco, Dec. 1975 Submitted for publication (NASA-TM-X-71069; X-920-75-308) Avail: NTIS HC \$3.50 CSCL 08N

The Goddard Apollo-Soyuz Geodynamics Experiment is described. It was performed to demonstrate the feasibility of tracking and recovering high frequency components of the earth's gravity field by utilizing a synchronous orbiting tracking station such as ATS-6. Gravity anomalies of 5 MGLS or larger having wavelengths of 300 to 1000 kilometers on the earth's surface are important for geologic studies of the upper layers of the earth's crust. Short wavelength Earth's gravity anomalies were detected from space. Two prime areas of data collection were selected for the experiment: (1) the center of the African continent and (2) the Indian Ocean Depression centered at 5° north latitude and 75° east longitude. Preliminary results show that the detectability objective of the experiment was met in both areas as well as at several additional anomalous areas around the globe. Gravity anomalies of the Karakoram and Himalayan mountain ranges, ocean trenches, as well as the Diamantina Depth, can be seen. Maps outlining the anomalies discovered are shown.

Author

**N76-18733#** Applied Physics Lab., Johns Hopkins Univ., Laurel, Md.  
**THE AMPLITUDE DISTRIBUTION OF FIELD-ALIGNED CURRENTS AT NORTHERN HIGH LATITUDES OBSERVED BY TRIAD Interim Report**  
Takeshi Iijima and Thomas A. Potemra Aug. 1975 37 p refs Sponsored by ONR (NR Proj. 323-013) (AD-A016175) Avail: NTIS CSCL 04/1

The spatial distribution and magnitudes of field-aligned currents at 800 km altitude over northern high latitudes were determined from TRIAD magnetometer data recorded at College, Alaska, during the period from July 1973 to October 1974.

GRA

**N76-18734#** Environmental Research and Technology, Inc., Concord, Mass.  
**THE ESTIMATION OF CLEAR SKY EMISSION VALUES FROM CLOUDY RADIOMETRIC DATA Final Report, Sep. 1974 - Jun. 1975**  
Mary Grace Fowler, Nien Dak Sze, Norman E. Gaut, and David T. Chang Aug. 1975 58 p refs (Contract F19628-75-C-0035; AF Proj. 8682) (AD-A016765; ERT-P-1234F; AFCRL-TR-75-0440) Avail: NTIS CSCL 04/1

This report determines the effects of clouds on sidelooking microwave radiometers and develops a technique to adjust cloudy emission values to equivalent clear emission measurements. Clouds of varying liquid water contents and altitudes were used with atmospheres representative of the arctic, mid-latitudes, and tropics. Their effects on microwave brightness temperatures were examined for frequencies between 15 and 55 GHz on a ground-based radiometer viewing at zenith angles from 0 degrees to 89 degrees. The strongest cloud effects were found for low elevation angles at frequencies away from the water vapor and oxygen lines. A technique is proposed which uses cloudy emission measurements made by a scanning two-channel radiometer, and a statistical inversion procedure, to infer equivalent clear emission values.

GRA

**N76-18755#** National Academy of Sciences - National Research Council, Washington, D.C.  
**THE OCEAN'S ROLE IN CLIMATE PREDICTION**  
Dec. 1974 64 p refs Sponsored in part by ONR (Contract NSF C-310) (AD-A016719; LC-74-29111) Avail: NTIS CSCL 04/2

This report is intended to provide an overview of the present and projected large projects currently related to the second Global Atmospheric Research Program (GARP) objective to understand the role of ocean in climate; to formulate specific questions that appear to be vital to our understanding of the role of the ocean in climate; to report on the activities that are actually taking place and to access how they stand in regard to the total task that needs to be done; and, to indicate where the first GARP Global Experiment (FGGE) provides opportunities toward understanding the ocean-atmosphere climate problem.

GRA

**N76-19207#** World Meteorological Organization, Geneva (Switzerland).

**WORLD WEATHER WATCH: GLOBAL OBSERVING SYSTEM - SATELLITE SUB-SYSTEM. INFORMATION ON METEOROLOGICAL SATELLITE PROGRAMMES OPERATED BY MEMBERS AND ORGANIZATIONS**

1975 71 p (WMO-411; ISBN-92-63-10411-5) Avail: NTIS HC \$4.50; WMO, Geneva

Current information on the meteorological satellite program of the European Space Agency, Japan, U.S.S.R. and the U.S. is presented. Details include the satellite orbits, data collection and transmission specifications and sensory equipment.

ESA

**N76-19507\*** National Oceanic and Atmospheric Administration, Washington, D.C.

**A CLOUD PHYSICS INVESTIGATION UTILIZING SKYLAB DATA Final Report**

John Alishouse, Herbert Jacobowitz, and David Wark, Principal Investigators [1975] 39 p refs EREP (NASA Order T-4715-B) (E76-10196; NASA-CR-147474) Avail: NTIS HC \$4.00 CSCL 04B

The author has identified the following significant results. A number of new scattering calculations for various models were performed. An atmospheric transmittance program to calculate transmittances on a line-by-line basis was developed for the oxygen A band. A copy of the LOWTRAN 2 program was obtained and modified slightly. Thermodynamic results were obtained from snow, cirrus, and coastal stratus to indicate that 1(1.6)/1(2.125) ratio is probably not a reliable indicator of snow, ice particles, or water droplets.

**N76-19509\*** Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.

**COMPUTER-AIDED ANALYSIS OF SKYLAB MULTISPECTRAL SCANNER DATA IN MOUNTAINOUS TERRAIN FOR LAND USE, FORESTRY, WATER RESOURCE, AND GEOLOGIC APPLICATIONS Final Report, 1 Apr. 1973 - 31 Dec. 1975**

Roger M. Hoffer, Principal Investigator 12 Dec. 1975 398 p refs Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 EREP (Contract NAS9-13380) (E76-10201; NASA-CR-147473; LARS-Inform-Note-121275) Avail: NTIS HC \$10.75 CSCL 08F

The author has identified the following significant results. One of the most significant results of this Skylab research involved the geometric correction and overlay of the Skylab multispectral scanner data with the LANDSAT multispectral scanner data, and also with a set of topographic data, including elevation, slope, and aspect. The Skylab S192 multispectral scanner data had distinct differences in noise level of the data in the various wavelength bands. Results of the temporal evaluation of the SL-2 and SL-3 photography were found to be particularly important for proper interpretation of the computer-aided analysis of the SL-2 and SL-3 multispectral scanner data. There was a quality problem involving the ringing effect introduced by digital filtering. The modified clustering technique was found valuable when working with multispectral scanner data involving many wavelength bands and covering large geographic areas. Analysis

of the SL-2 scanner data involved classification of major cover types and also forest cover types. Comparison of the results obtained with Skylab MSS data and LANDSAT MSS data indicated that the improved spectral resolution of the Skylab scanner system enabled a higher classification accuracy to be obtained for forest cover types, although the classification performance for major cover types was not significantly different.

**N76-19511\*#** Boeing Aerospace Co., Seattle, Wash. Research and Engineering Div.

**QUANTITATIVE DETERMINATION OF STRATOSPHERIC AEROSOL CHARACTERISTICS** Final Report, Jul. 1973 - Dec. 1975

David L. Tingey and John Potter, Principal Investigators (Lockheed Electronics Co., Houston, Tex.) Dec. 1975-246 p refs EREP (Contract NAS9-13303)

(E76-10203; NASA-CR-147444; D180-19209-1) Avail: NTIS HC \$8.00 CSCL 04A

The author has identified the following significant results. In the S192 data, a peak was apparent in the lower altitudes that was not present in the shorter wavelengths and grew with increasing wavelength beginning with band 7. For ten S192 wavelengths, the relative altitude increment was determined by knowledge of the relative position of the highest point in the scan arc. Using this scheme, results of scaling and inverting data for passes 47 and 61 were put into two models. Each result had three chart representations: (1) limb brightness measurement, (2) attenuation coefficients, and (3) ratio of the aerosol and Rayleigh coefficients to accentuate layers.

**N76-19517\*#** Geological Survey, Reston, Va.

**ANALYSIS OF SKYLAB IMAGERY FOR APPLICATION TO THEMATIC MAPPING** Final Report

Doyle G. Smith, Principal Investigator Jan. 1976 47 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 EREP (NASA Order T-4649-B)

(E76-10214; NASA-CR-147443) Avail: NTIS HC \$4.00 CSCL 08B

**N76-19519\*#** Earth Satellite Corp., Washington, D.C.

**APPLICATION OF SKYLAB EREP DATA FOR LAND USE MANAGEMENT** Final Report

David S. Simonett, Principal Investigator Jan. 1976 306 p refs Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 EREP (Contract NAS9-13314)

(E76-10216; NASA-CR-147457; G-093) Avail: NTIS HC \$9.75 CSCL 08B

The author has identified the following significant results. The 1.09-1.19 micron band proved to be very valuable for discriminating a variety of land use categories, including agriculture, forest, and urban classes. The 1.55-1.75 micron band proved very useful in combination with the 1.09-1.19 micron band. Misregistration between spectral bands, even by as little as 1/2 pixel, may degrade classification accuracy. Identification accuracy of boundary or border pixels was as much as 13% lower than the accuracy for identifying internal field pixels. The principal conclusion with respect to the S190B camera system is that the higher resolution of the S190B system in comparison to previous space photography (Gemini, Apollo), to the S190A system (Skylab), and to LANDSAT imagery significantly increases the range of additional discrimination achievable.

**N76-19523\*#** Delaware Univ., Newark. Coll. of Marine Studies.

**SPECTRAL REFLECTANCE SIGNATURES OF COASTAL POLLUTANTS**

V. Klemas, Principal Investigator, W. Philpot, and G. Davis 19 Jan. 1976 2 p ERTS (Grant NsG-1149)

(E76-10220; NASA-CR-146321) Avail: NTIS HC \$3.50 CSCL 13B

The author has identified the following significant results. Remote sensing from satellites and aircraft was combined with ground truth collected from ships in an attempt to classify coastal and estuarine water types by their spectral reflectance signatures. During ocean waste disposal operations 40 miles off the Delaware coast, water samples were collected and spectroradiometric measurements conducted in the field to provide ground truth for aircraft and LANDSAT overpasses with multispectral scanners.

**N76-19527\*#** Delaware Univ., Newark. Coll. of Marine Studies.

**COASTAL ZONE CLASSIFICATION FROM SATELLITE IMAGERY**

V. Klemas, Principal Investigator, D. Bartlett, R. Rogers (Bendix Aerospace Systems Corp.), and L. Reed (Bendix Aerospace Systems Corp.) 6 Jan. 1976 2 p ERTS (Contract NAS5-20983)

(E76-10224; NASA-CR-146335) Avail: NTIS HC \$3.50 CSCL 08J

The author has identified the following significant results. Studies of cover distribution along Delaware's coast, especially in tidal wetlands, were made, utilizing semi-automated analysis of LANDSAT-1 MSS digital data. Cover maps with eleven vegetation and other cover categories were produced with accuracy of identification above 80% in all categories. Recent studies have tested a new technique for training automated analysis which uses ground measured reflectance and atmospheric correction techniques to derive signatures for specific categories in preference to the relative radiance signatures derived from training sets within LANDSAT data itself. Initial tests using a four category scheme indicate that training data based on absolute measured reflectance and atmospheric correction of LANDSAT data can produce comparable accuracy of categorization to that achieved using more conventional relative radiance training. The analysis of the same four categories produced average categorization accuracies of 82.1% by conventional relative radiance training and 81.9% by use of absolute reflectance signatures.

**N76-19528\*#** Delaware Univ., Newark. Coll. of Marine Studies.

**VERIFICATION BY REMOTE SENSING OF AN OIL SLICK MOVEMENT PREDICTION MODEL**

V. Klemas, Principal Investigator, G. Davis, and H. Wang 14 Jan. 1976 2 p ERTS (Contract NAS5-20983)

(E76-10225; NASA-CR-146336) Avail: NTIS HC \$3.50 CSCL 13B

The author has identified the following significant results. LANDSAT, aircraft, ships, and air-dropped current drogues were deployed to determine current circulation and to track oil slick movement on four different dates in Delaware Bay. The results were used to verify a predictive model for oil slicks given their size, location, tidal stage (current), weather (wind), and nature of crude. Both LANDSAT satellites provided valuable data on gross circulation patterns and convergent coastal fronts which by capturing oil slicks significantly influence their movement and dispersion.

**N76-19539\*#** National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.

**MULTILAYERED MODELS FOR ELECTROMAGNETIC REFLECTION AMPLITUDES**

William I. Linfor Mar. 1976 55 p refs (NASA-TR-R-438; A-5862) Avail: NTIS HC \$4.50 CSCL 08L

The remote sensing of snowpack characteristics with surface installations or with an airborne system could have important applications in water resource management and flood prediction. To derive some insight into such applications, the electromagnetic response of multilayer snow models is analyzed. Normally incident plane waves are assumed at frequencies ranging from 10 to the 6th power to 10 to the 10th power Hz, and amplitude reflection coefficients are calculated for models having

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various snow-layer combinations, including ice sheets. Layers are defined by a thickness, permittivity, and conductivity; the electrical parameters are constant or prescribed functions of frequency. To illustrate the effect of various layering combinations, results are given in the form of curves of amplitude reflection coefficients, versus frequency for a variety of models. Under simplifying assumptions, the snow thickness and effective dielectric constant can be estimated from the reflection coefficient variations as a function of frequency. Author

**N76-19544#** Enviro Control, Inc., Rockville, Md.  
**STUDY OF FEDERAL WATER QUALITY MONITORING EFFICIENCY** Final Report  
A. Hershaft 15 Mar. 1975 162 p refs Sponsored by Council on Environ. Quality  
(PB-246221/6; EQ-4AC0141) Avail: NTIS HC \$6.75 CSCL 13B

A critical review and analysis is presented of federal policies and practices concerning water quality monitoring. The nature and objectives of monitoring, data collection requirements, and processing and dissemination requirements are included. GRA

**N76-19596\*#** Old Dominion Univ. Research Foundation, Norfolk, Va. School of Sciences and Health Professions.  
**PARAMETERIZATION OF GASEOUS CONSTITUENCIES CONCENTRATION PROFILES IN THE PLANETARY BOUNDARY LAYER AS REQUIRED IN SUPPORT OF AIRBORNE AND SATELLITE BORNE SENSORS** Technical Report.  
1 Feb. - 31 Jan. 1975  
Earl C. Kindle, Estelle Condon, and Joseph Casas Mar. 1976 15 p refs  
(Grant NSG-1127)  
(NASA-CR-146307; PGSTR-AP76-21) Avail: NTIS HC \$3.50 CSCL 13B

The research to develop the capabilities for sensing air pollution constituencies using satellite or airborne remote sensors is reported. Sensor evaluation and calibration are analyzed including data reduction. The proposed follow-on research is presented. F.O.S.

**N76-19597\*#** Texas Univ. Health Science Center, Houston. School of Public Health.  
**RESPIRABLE PARTICULATE MONITORING WITH REMOTE SENSORS. (PUBLIC HEALTH ECOLOGY: AIR POLLUTION)** Final Report, 1 Jul. 1971 - 31 Oct. 1973  
Richard K. Severs Jan. 1974 292 p refs Original contains color illustrations  
(Contract NAS9-12041)  
(NASA-CR-147504) Avail: NTIS HC \$9.25 CSCL 13B

The feasibility of monitoring atmospheric aerosols in the respirable range from air or space platforms was studied. Secondary reflectance targets were located in the industrial area and near Galveston Bay. Multichannel remote sensor data were utilized to calculate the aerosol extinction coefficient and thus determine the aerosol size distribution. Houston Texas air sampling network high volume data were utilized to generate computer isopleth maps of suspended particulates and to establish the mass loading of the atmosphere. In addition, a five channel nephelometer and a multistage particulate air sampler were used to collect data. The extinction coefficient determined from remote sensor data proved more representative of wide areal phenomena than that calculated from on site measurements. It was also demonstrated that a significant reduction in the standard deviation of the extinction coefficient could be achieved by reducing the bandwidths used in remote sensor. Author

**N76-19627#** Raytheon Co., Sudbury, Mass. Equipment Div.  
**REMOTE MEASUREMENT OF POWER PLANT SMOKE STACK EFFLUENT VELOCITY** Final Report  
C. M. Sonnenschein Aug. 1975 127 p refs  
(Contract EPA-68-02-1752)  
(PB-245792/7; EPA-650/2-75-062) Avail: NTIS HC \$6.00 CSCL 13B

Demonstration is described of the ability of a CO<sub>2</sub> Laser Doppler Velocimeter (LDV) to measure remotely the velocity of the effluent from a power plant smoke stack. The basis of the technique is that laser radiation backscattered from particulates in the effluent is Doppler shifted infrequency in proportion to the velocity of the effluent. Measurements were made against a coal burning power plant equipped with electrostatic precipitators to remove particulates from the boiler flue gases. Based on the results of the measurements a study on the design of an LDV optimized for the measurement of power plant effluent velocities was performed. GRA

**N76-19635#** Environmental Research Inst. of Michigan, Ann Arbor. Infrared and Optics Div.  
**THE FEASIBILITY OF OIL-POLLUTION DETECTION AND MONITORING FROM SPACE, EXAMPLES USING ERTS-1 AND SKYLAB DATA** Final Report  
Gary C. Goldman and Robert Horvath Aug. 1975 58 p refs  
(Contract DOT-CG-24063-A)  
(AD-A017098; USCG-D-117-75) Avail: NTIS CSCL 13/2

The necessity of detecting and monitoring an increasing number of coastal oil spills has precipitated an extensive U.S. Coast Guard evaluation of various surveillance methods. The purpose of this study was to determine and demonstrate the present and future utility of space-acquired remote sensor data, as an aid to the Coast Guard in fulfilling its assigned mission in the area of oil pollution detection and monitoring and law enforcement, by specifically evaluating ERTS-1 and SKYLAB capabilities. Various digital-computer and photointerpretation methods were attempted in order to develop, or at least evaluate, the best means of analyzing the data. GRA

**N76-19696** Atmospheric Environment Service, Toronto (Ontario).  
**GLOBAL ATMOSPHERIC MONITORING SYSTEMS**  
R. E. Munn In WMO The Phys. Basis of Climate and Climate Modelling Apr. 1975 p 258-265 refs

Copyright.

Principles that should be considered in the design of monitoring systems are reviewed followed by a description of existing and planned global atmospheric monitoring systems. These include the WMO World Weather Watch, the WMO Climate Network, the WMO World Radiation Network, the World Data Centers, the WMO Regional and Baseline Air Chemistry Networks, and the Global Environmental Monitoring System. ESA

**N76-19697#** World Meteorological Organization, Geneva (Switzerland).  
**LONG-TERM CLIMATIC FLUCTUATIONS**  
1975 515 p refs Proc. of a Symp. held at Norwich, Ontario, 18-23 Aug. 1975; sponsored by Intern. Assoc. of Meteorology and Atmospheric Phys.  
(WMO-421) Avail: NTIS HC \$12.75; WMO, Geneva

The following broad subject areas are covered: global paleoclimatic chronology; stable isotopes - studies of the last glaciation and since; holocene and recent events; patterns of climatic change; statistical properties of climatic change; theory of climate and climatic change; numerical modeling of climatic change; climate predictability and the future; and impact of man and the international economy of current and future climatic changes.

**N76-19759#** National Weather Service, Salt Lake City, Utah. Western Region.  
**DIGITIZED EASTERN PACIFIC TROPICAL CYCLONE TRACTS**  
Robert A. Baum and Glenn E. Rasch Sep. 1975 198 p ref  
(COM-75-11479/3; NOAA-TM-NWS-WR-101;  
NOAA-75100701) Avail: NTIS HC \$7.50 CSCL 04B

The report presents a climatological display that indicates the probability of a tropical cyclone located in a given part of

the Pacific Ocean eventually moving onto the Mexican Coast. The study encompasses all sections of the central and eastern North Pacific. A series of 184 charts is presented consisting of two maps showing the source and eventual disposition of tropical cyclones passing through 2-1/2 degree latitude-longitude boxes during 14-year period, 1961-1974, and a bargraph showing the daily distribution of the storms which passed through the boxes. Also included is the number of storms that passed through each box and, when the total was five or more, the mean vector direction and speed and the mean scalar speed of the cyclones as they passed through the box. The Poisson probability of at least one cyclone being in any 2-1/2 x 2-1/2 degree box in any season is shown. GRA

**N76-19761#** East Anglia Univ., Norwich (England). Climate Research Unit.

**PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON MAPPING THE ATMOSPHERIC AND OCEANIC CIRCULATIONS AND OTHER CLIMATIC PARAMETERS AT THE TIME OF THE LAST GLACIAL MAXIMUM ABOUT 17,000 YEARS AGO, AND COMPARISONS WITH TODAY'S CONDITIONS AND THOSE OF THE SO-CALLED LITTLE ICE AGE IN RECENT CENTURIES. COLLECTED ABSTRACTS** H. H. Lamb 1974 136 p refs Conf. held at England, 22 May 1973

(PB-245573/1; UEA-CRU-RP-2) Avail: NTIS HC \$6.00 CSCL 04B

This is a record of the proceedings of the international (CLIMAP) conference held at Norwich, England in May 1973. The book is divided into seven different sections and related reports are enclosed within. The seven sections deal with (1) techniques; (2) the ocean record in maps; (3) the land record; (4) the ocean record and comparisons with the land record and between the hemispheres; (5) the little ice age and present climate; (6) meteorological analysis and interpretation of the available data on past climate; and (7) other approaches to the mapping problem and the relevance of mapping past climatic regimes to the practical problems of the present day and the future. GRA

**N76-20577#** New Mexico State Bureau of Mines and Mineral Resources, Socorro.

**EARTH RESOURCES EVALUATION FOR NEW MEXICO BY LANDSAT-2** Progress Report, 1 Dec. 1975 - 29 Feb. 1976 David E. Tabet, Principal Investigator, Frank E. Kottowski, Michael H. Inglis, Linda L. Love, and Stanley A. Morain 29 Feb. 1975 4 p refs ERTS

(Contract NAS5-20916) (E76-10226; NASA-CR-146337) Avail: NTIS HC \$3.50 CSCL 05B

**N76-20581#** Mississippi State Office of Science and Technology, Jackson.

**APPLICATION AND EVALUATION OF SATELLITE REMOTE SENSING DATA AND AUTOMATIC PROCESSING TECHNIQUES FOR STATE-WIDE LAND USE AND OTHER RESOURCE MANAGEMENT** Progress Report, period ending 21 Jan. 1976

P. T. Bankston, Principal Investigator Jan. 1976 6 p ERTS (Contract NAS5-20918)

(E76-10231; NASA-CR-146514) Avail: NTIS HC \$3.50 CSCL 05B

**N76-20584#** Nebraska Univ., Lincoln. Conservation and Survey Div.

**APPLICATION OF LANDSAT IMAGERY IN LAND USE INVENTORY AND CLASSIFICATION IN NEBRASKA** Progress Report, 10 Dec. 1975 - 10 Mar. 1976

Marvin P. Carlson, Principal Investigator and Paul M. Seevers 10 Mar. 1976 5 p ERTS

(Contract NAS5-20814) (E76-10236; NASA-CR-146519) Avail: NTIS HC \$3.50 CSCL 08B

**N76-20586#** Boeing Co., Kent, Wash.

**QUANTITATIVE DETERMINATION OF STRATOSPHERIC AEROSOL CHARACTERISTICS** Monthly Report, Sep. 1975 David L. Tingley and John Potter, Principal Investigators 1975 1 p EREP

(Contract NAS9-13303)

(E76-10238; NASA-CR-146521) Avail: NTIS HC \$3.50 CSCL 04A

**N76-20590#** California State Dept. of Water Resources, Sacramento.

**[WATER QUALITY CONDITIONS IN SAN FRANCISCO BAY DELTA]** Progress Report

Randall L. Brown, Principal Investigator 15 Jan. 1976 2 p ERTS

(Contract NAS5-20945)

(E76-10242; NASA-CR-146525; PR-2) Avail: NTIS HC \$3.50 CSCL 05B

**N76-20591#** Kentucky Dept. of Natural Resources and Environmental Protection, Frankfort.

**[ENVIRONMENTAL EFFECTS OF STRIP MINING]** Quarterly Progress Report, 21 Aug. - 21 Nov. 1975

Birney R. Fish, Principal Investigator 21 Nov. 1975 3 p Sponsored by NASA ERTS

(E76-10243; NASA-CR-146526; QPR-3) Avail: NTIS HC \$3.50 CSCL 05B

**N76-20595#** Federation of Rocky Mountain States, Inc., Denver, Colo.

**A REGIONAL LAND USE SURVEY BASED ON REMOTE SENSING AND OTHER DATA** Quarterly Report, 10 Jul. - 10 Oct. 1975

George Nez, Principal Investigator 10 Oct. 1975 33 p ERTS (Contract NAS5-22338)

(E76-10248; NASA-CR-146530; QR-2) Avail: NTIS HC \$4.00 CSCL 08B

**N76-20602#** Environmental Research and Technology, Inc., Concord, Mass.

**THE USE OF LANDSAT DATA TO STUDY MESOSCALE CLOUD FEATURES** Quarterly Progress Report, Jul. - Sep. 1975

Mary Grace Fowler, Principal Investigator, C. James Bowley, Pieter Feteris, and Anthony Lisa Oct. 1975 14 p ERTS

(Contract NAS5-20804)

(E76-10255; NASA-CR-146627; P-619-3) Avail: NTIS HC \$3.50 CSCL 04B

**N76-20603#** Wisconsin Univ., Milwaukee. Air Pollution Analysis Lab.

**USE OF LANDSAT DATA IN MONITORING PATTERNS OF AEROSOL POLLUTANTS AND MESOMETEOROLOGICAL EVENTS** Final Report

Walter A. Lyons, Principal Investigator Sep. 1975 64 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Contract NAS5-21736)

(E76-10256; NASA-CR-146628) Avail: NTIS HC \$4.50 CSCL 13B

**N76-20606#** Department of Scientific and Industrial Research, Wellington (New Zealand).

**LANDSAT INVESTIGATION PROGRAM. PART 1: DEVELOPMENT OF REMOTE SENSING TECHNOLOGY IN NEW ZEALAND. PART 2: MAPPING LAND USE AND ENVIRONMENTAL STUDIES IN NEW ZEALAND. PART 3: INDIGENOUS FOREST ASSESSMENT. PART 4: SEISMOTECTONIC, STRUCTURAL, VOLCANOLOGIC AND GEOMORPHOLOGIC**



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### **PHIC STUDY OF NEW ZEALAND Quarterly Report**

Mervyn C. Probie, Richard P. Suggate, Ian F. Stirling, and Michael G. McGreevy, Principal Investigators Mar. 1976 49 p refs  
Sponsored by NASA Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS (E76-10260; NASA-CR-146632; Rept-508; QR-1) Avail: NTIS HC \$4.00 CSCI 08B

**N76-20609\*** Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.

### **THE APPLICATION OF REMOTE SENSING TECHNOLOGY TO THE SOLUTION OF PROBLEMS IN THE MANAGEMENT OF RESOURCES IN INDIANA Semiannual Status Report, 1 Jan. - 30 Nov. 1975**

R. A. Weismiller, Principal Investigator 30 Nov. 1975 77 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS (Grant NGL-15-005-186) (E76-10264; NASA-CR-146636) Avail: NTIS HC \$5.00 CSCI 08F

**N76-20612\*** Environmental and Regional Research Associates, Inc., Johnson City, Tenn.

### **TOWARD THE MODELING OF LAND USE CHANGE: A SPATIAL ANALYSIS USING REMOTE SENSING AND HISTORICAL DATA Final Report**

Robert B. Honea, Feb. 1976 194 p refs  
(Contract NAS8-30595) (NASA-CR-144221; ERRA-73-48-Y) Avail: NTIS HC \$7.50 CSCI 08B

It was hypothesized that the chronological observation of land use change could be shown to follow a predictable pattern and these patterns could be correlated with other statistical data to develop transition probabilities suitable for modeling purposes. A literature review and preliminary research, however, indicated a totally stochastic approach was not practical for simulating land use change and thus a more deterministic approach was adopted. The approach used assumes the determinants of the land use conversion process are found in the market place, where land transactions among buyers and sellers occur. Only one side of the market transaction process is studied, however, namely, the purchaser's desires in securing an ideal or suitable site. The problem was to identify the ideal qualities, quantities or attributes desired in an industrial site (or housing development), and to formulate a general algorithmic statement capable of identifying potential development sites. Research procedures involved developing a list of variables previously noted in the literature to be related to site selection and streamlining the list to a set suitable for statistical testing. A sample of 157 industries which have located (or relocated) in the 16-county Knoxville metropolitan region since 1950 was selected for industrial location analysis. Using NASA color infrared photography and Tennessee Valley Authority historical aerial photography, data were collected on the spatial characteristics of each industrial location event. These data were then subjected to factor analysis to determine the interrelations of variables. Author

**N76-20700\*** Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany). Space Div.

### **AIR QUALITY MEASUREMENTS FROM SPACE PLATFORMS**

B. Kunkel, F. Wolz, H. J. Bolle (Munich Univ.), and E. Redemann (Munich Univ.) Paris ESA Dec. 1975 341 p refs  
(Contract ESRO-SC/70-HQ) (ESA-CR-577) Avail: NTIS HC \$10.00

A survey of the present knowledge of the atmosphere, its composition and structure of the air quality parameters, and the major information gaps is given. The impact of the various air quality parameters on the climate and the environments in general is discussed. Measurement requirements and possible missions are summarized. Present ground measurement techniques for the operational monitoring of air quality near the surface are

discussed. A summary of airborne air quality measurements and spaceborne applications and measurement principles, as well as a survey of the various remote sensor types, are given. The present space platforms for air quality measurements as well as the planned spacecraft missions such as Nimbus-G and Spacelab are introduced. The organizational data handling and distribution for an operational air quality system with remote sensing techniques and the likely benefits of such a system are discussed. The main possible users of worldwide distributed data are listed, including the major programs conducted or planned by these user groups. Author (ESA)

### **N76-20763\* Clarkson Coll. of Technology, Potsdam, N.Y. REMOTE SENSING OF PARTICLE SIZE AND REFRACTIVE INDEX BY VARYING THE WAVELENGTH**

Milton Kerker and Derry D. Cooke Oct. 1975 29 p refs  
(Grant NOAA-04-4-022-21) (PB-246964/1; NOAA-75102903) Avail: NTIS HC \$4.00 CSCI 04A

This is a numerical study to explore the feasibility of determining particle size and refractive index in the atmosphere from the backscattered signal combined with a signal differentially scattered at one other angle. The wavelength of the radiation is varied over a broad range (in the particular example chosen, from  $\lambda = 0.5$  to  $1.5$  micrometer). Three signatures of the particle size and refractive index are chosen: (1) deviation of the radiance from the inverse fourth power of the wavelength, (2) the first maximum of the variation of the angular intensity function with wavelength, and (3) the first two maxima of the variation of the phase difference of the amplitudes of the polarized radiances with wavelength. For monodisperse systems, these signatures will permit estimation of particle size in the forty-fold range  $a = 0.033$  to  $1.29$  micrometers (for  $m = 1.50$ ). GRA

### **N76-20770\* Lockheed Missiles and Space Co., Palo Alto, Calif. CERTAIN RELATIONSHIPS BETWEEN PRECIPITATION AND THE FORM OF CLOUDINESS IN PHOTOGRAPHS FROM A SATELLITE**

T. P. Popova 1974 9 p refs Transl. into ENGLISH from Tr. Gidrometeorolog. Nauchn.-Issled. Tsentr SSSR (Leningrad), no. 132, 1974 p 88-97  
Avail: NTIS HC \$3.50; National Translation Center, John Crerar Library, Chicago, Illinois 60616

The relationship between the area covered by clouds on a photograph from space and the area covered by precipitation on the earth's surface and the relationship between precipitation and values of the radiation temperature of the upper cloud boundary measured by satellite apparatus, are considered. It is indicated that satellite information can be used for a qualitative diagnosis of precipitation at earth's surface. Results are discussed of a statistical analysis of the relations between precipitation and the form of cloudiness on photographs from a satellite. Author

**N76-20787\* National Oceanic and Atmospheric Administration, Boulder, Colo. Environmental Research Labs.**

### **GEOPHYSICAL MONITORING FOR CLIMATIC CHANGE NO. 3. SUMMARY REPORT 1974**

John M. Miller Aug. 1975 113 p refs  
(PB-246961/7; NOAA-75103102) Avail: NTIS HC \$5.50 CSCI 04A

Geophysical Monitoring Program data for 1974 are included. Ozone, both surface concentrations and total amounts, carbon dioxide, chlorofluorocarbons, and aerosols were monitored. The 1974 carbon dioxide measurements show that the 1973-74 increase in annual concentration is the smallest of the decade dropping at Barrow, Mauna Loa, South Pole, and Cape Matatula (partial 7 month record) from more than  $1.5$  ppm per year to less than  $0.5$  ppm per year. It is known that the year-to-year increase is variable and thus it remains to be determined if the small 1973-74 increase was a statistical anomaly or due to physical changes. All of the Antarctic surface ozone data collected over the last 13 years have been assembled and put in computer

acceptable form. Also identified were areas where either further work or new instruments or both are necessary to obtain the data quality needed. GRA

**N76-20965#** Little (Arthur D.), Inc., Cambridge, Mass.  
**THEORY OF ABSORPTION AND SCATTERING BY LOSSY DIELECTRIC PARTICLES** Final Report

J. R. Aronson, A. G. Emslie, and P. F. Strong Jul. 1975 42 p refs  
 (Grant NOAA-03-4-022-121)  
 (PB-246965/8; ADL-C-77329; NOAA-75102902) Avail: NTIS HC \$4.00 CSCL 20F

The absorption and scattering properties of particulate materials are important in a variety of atmospheric problems. These include radiative transfer calculations which are important in climatology and remote sensing applications which are related to atmospheric pollution. The usual approach to calculation of the absorption and scattering properties of particulates is that of the Mie theory. Recently, a modification of the theory has been applied to interpret the infrared spectra obtained by Mariner 9. This theory is capable of handling statistical distributions of particles of differing shapes. Perhaps the most novel and important conclusion was the concept of enhanced absorption by edges and surface asperities on particles. However, a rigorous theoretical proof of this mechanism was lacking and the inferences of such a mechanism were based upon the comparisons of a heuristic theoretical treatment with experimental measurements on densely packed powders and roughened crystals. To show that the extra absorption by edges, postulated is solidly based in theory was attempted. GRA

**N76-21122#** National Environmental Satellite Service, Washington, D.C.  
**RADIATION BUDGET DATA FROM THE METEOROLOGICAL SATELLITES, ITOS 1 AND NOAA 1**

Donald H. Flanders and William L. Smith Aug. 1975 26 p refs  
 (PB-246877/5; NOAA-TM-NESS-72; NOAA-75102201) Avail: NTIS HC \$4.00 CSCL 04A

The procedures used to process the Flat Plate Radiometer data from the two satellites (ITOS 1 and NOAA 1) are described. The results are presented for the periods of good data acquisition: 23 March through 25 June 1970 for ITOS 1 and 18 February through 16 March and 10 May through 27 May 1971 for NOAA 1. GRA

**N76-21383#** Naval Research Lab., Washington, D.C.  
**DETECTION OF STATIONARY TARGETS IN SEA CLUTTER USING A CW DUAL-FREQUENCY RADAR** Interim Report  
 William J. Plant 11 Nov. 1975 15 p refs  
 (NRL Proj. R02-37; RR0210141)  
 (AD-A018134; NRL-7934) Avail: NTIS CSCL 17/9

A coherent, CW, X-band, dual-frequency radar has been used to detect stationary targets in the Chesapeake Bay. It is shown that by multiplying returns at two frequencies and averaging, sea clutter is suppressed. If the decorrelation of the two clutter returns is greater than that of returns from a stationary target, the signal-to-clutter ratio of the two-frequency system is shown to be greater than that of a comparable single-frequency radar.

Author (GRA)

**N76-21625#** Centre National d'Etudes Spatiales, Toulouse (France).

**THE POSSIBILITY OF EVALUATING VERTICAL WIND PROFILES FROM SATELLITE DATA** Final Report

A. Villeville, Principal Investigator and A. B. Weiller [1975] 42 p Sponsored by NASA. Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 EREP (E76-10210; NASA-CR-147475) Avail: NTIS HC \$4.00 CSCL 04B

**N76-21626#** National Aeronautics and Space Administration, Lyndon B. Johnson Space Center, Houston, Tex.

**COMPUTER IMPLEMENTED LAND USE CLASSIFICATION WITH ERTS DIGITAL DATA DURING THREE SEASONS**

Armond T. Joyce, Principal Investigator Jun. 1974 23 p refs  
 Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 EREP (E76-10228; NASA-TM-X-72993; Rept-135) Avail: NTIS HC \$3.50 CSCL 05B

**N76-21628#** Texas Univ., Austin, Dept. of Astronomy.  
**ULTRAVIOLET STELLAR ASTRONOMY**

Karl G. Henize, James D. Wray, Yoji Kondo (NASA Johnson Space Center), and Fred OCallaghan, Principal Investigators (Perkin-Elmer Corp.) Dec. 1975 103 p refs EREP (Contract NAS9-13176)

(E76-10235; NASA-CR-147488) Avail: NTIS HC \$5.50 CSCL 03A

The author has identified the following significant results: During all three Skylab missions, prism-on observations were obtained in 188 starfields and prism-off observations in 31 starfields. In general, the fields are concentrated in the Milky Way where the frequency of hot stars is highest. These fields cover an area approximately 3660 degrees and include roughly 24 percent of a band 30 deg wide centered on the plane of the Milky Way. A census of stars in the prism-on fields shows that nearly 6,000 stars have measurable flux data at a wavelength of 2600A, that 1,600 have measurable data at 2000A, and that 400 show useful data at 1500A. Obvious absorption or emission features shortward of 2000A are visible in approximately 120 stars. This represents a bonanza of data useful for statistical studies of stellar classification and of interstellar reddening as well as for studies of various types of peculiar stars!

**N76-21629#** Minnesota State Planning Agency, St. Paul.  
**ANALYSIS OF DATA FOR LANDSAT (ERTS) FOLLOW-ON Progress Report, 26 Jun. - 25 Sep. 1975**

Joseph E. Sizer, Principal Investigator 19 Nov. 1975 10 p ERTS  
 (Contract NAS5-20985)  
 (E76-10245; NASA-CR-146527) Avail: NTIS HC \$3.50 CSCL 05B

**N76-21631#** National Space Development Agency, Tokyo (Japan).

**STUDY OF MESOSCALE PHENOMENA, WINTER MONSOON CLOUDS AND SNOW AREA BASED ON LANDSAT DATA**

Kiyoshi Tsuchiya, Principal Investigator Jan. 1976 33 p refs  
 Sponsored by NASA. Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS (E76-10261; NASA-CR-146633) Avail: NTIS HC \$4.00 CSCL 08L

The author has identified the following significant results. Most longitudinal clouds which appear as continuous linear clouds are composed of small transversal clouds. There are mountain waves of different wavelength in a comparatively narrow area indicating complicated orographical effects on wind and temperature distribution or on both dynamical and static stability condition. There is a particular shape of cirrus cloud suggestive of turbulence in the vicinity of CAT in the upper troposphere near jet stream level and its cold air side. Thin cirrus of overcast condition can be distinguished by MSS; however, extremely thin cirrus of partly cloudy condition cannot be detected even in LANDSAT data. This presents a serious problem in the interpretation of satellite thermal infrared radiation data since they affect the value.

**N76-21640#** Colorado State Univ., Fort Collins, Dept. of Earth Resources.

**SIGNATURE EXTENSION FOR SUN ANGLE, VOLUME 2**  
 Final Report, 15 Nov. 1974 - 14 Nov. 1975

## 02 ENVIRONMENTAL CHANGES AND CULTURAL RESOURCES

J. A. Smith, Principal Investigator, J. K. Berry, and F. Heimes.  
Nov. 1975 130 p refs EREP  
(Contract NAS9-14467)  
(E76-10273; NASA-CR-147465) Avail: NTIS HC \$6.00 CSCL  
03B

**N76-21641\*#** National Aeronautics and Space Administration.  
John F. Kennedy Space Center, Cocoa Beach, Fla.  
**PLANNING APPLICATIONS IN EAST CENTRAL FLORIDA**  
**Progress Report, 12 Nov. 1975 - 11 Feb. 1976**  
John W. Hannah (Brevard County Planning Dept., Fla.), Garland  
L. Thomas, and Fernando Esparza, Principal Investigators 11 Feb.  
1976 29 p ref ERTS  
(Contract NAS5-20907)  
(E76-10274; NASA-TM-X-73043; BCPD-L2-4) Avail: NTIS  
HC \$4.00 CSCL 08B

**N76-21644\*#** Department of Industry, London (England).  
**THE IDENTIFICATION OF CLOUD TYPES IN LANDSAT MSS**  
**IMAGES Quarterly Report**  
Eric C. Barrett, Principal Investigator and Colin K. Grapt Mar.  
1976 46 p refs Sponsored by NASA and United Kingdom  
Dept. of Industry Original contains imagery. Original photography  
may be purchased from the EROS Data Center, 10th and Dakota  
Avenue, Sioux Falls, S. D. 57198 ERTS  
(E76-10277; NASA-CR-146647; QR-2) Avail: NTIS  
HC \$4.00 CSCL 04B

The author has identified the following significant results:  
Five general families of clouds were identified: cumulonimbiform;  
cumuliform, stratiform, stratocumuliform, and cirriform. Four  
members of this five-fold primary division of clouds were further  
divided into a number of subgroups. The MSS observed and  
recorded earth radiation in four different wavebands. Two of  
these bands (4 and 5) image in the visible portion of the  
electromagnetic spectrum, while the others (6 and 7) image the  
short wave portion, or just into the infrared. The main differences  
between the appearances of clouds in the four wavebands are  
related to the background brightness of land and sea surfaces.

**N76-21645\*#** National Univ. of Lesotho, Roma. Dept. of  
Biology.  
**NATURAL RESOURCES RESEARCH AND DEVELOPMENT**  
**IN LESOTHO USING LANDSAT IMAGERY Quarterly Report,**  
**Dec. 1975 - Feb. 1976**  
A. A. Jackson, Principal Investigator 3 Mar. 1976 8 p  
Sponsored by NASA and Environmental Res. Inst. of Michigan  
ERTS  
(E76-10278; NASA-CR-146648; LLII/1) Avail: NTIS  
HC \$3.50 CSCL 08F

The author has identified the following significant results. A  
map of the drainage of the whole country to include at least  
third order streams was constructed from LANDSAT imagery.  
This was digitized and can be plotted at any required scale to  
provide base maps for other cartographic projects. A suite of  
programs for the interpretation of digital LANDSAT data is under  
development for a low cost programmable calculator. Initial  
output from these programs has proved to have better resolution  
and detail than the standard photographic products, and was to  
update the standard topographic map of a particular region.

**N76-21646\*#** Instituto Geografico y Catastral, Madrid (Spain).  
**THEMATIC MAPPING, LAND USE, GEOLOGICAL STRUC-**  
**TURE AND WATER RESOURCES IN CENTRAL SPAIN**  
**Quarterly Report**  
Nunez Delas Cuevas, Principal Investigator 15 Feb. 1976 17 p  
Sponsored by NASA Original contains color illustrations ERTS  
(E76-10279; NASA-CR-146649; QR-1) Avail: NTIS  
HC \$3.50 CSCL 08B

**N76-21656\*#** Arizona Univ., Tucson. Office of Arid Lands  
Studies.  
**APPLIED REMOTE SENSING PROGRAM (ARSP) Quarterly**  
**Progress Report, 14 Aug. 1975 - 13 Feb. 1976**

Kenneth Foster, Principal Investigator 13 Feb. 1976 11 p  
Sponsored by NASA ERTS  
(E76-10289; NASA-CR-146781; QR-3; QR-4) Avail: NTIS  
HC \$3.50 CSCL 08B

**N76-21657\*#** Arizona Univ., Tucson. Office of Arid Lands  
Studies.  
**APPLIED REMOTE SENSING PROGRAM (ARSP) Quarterly**  
**Progress Report, 14 May - 13 Aug. 1975**  
Kenneth Foster, Principal Investigator 13 Aug. 1975 4 p  
Sponsored by NASA ERTS  
(E76-10290; NASA-CR-146782; QR-2) Avail: NTIS  
HC \$3.50 CSCL 08B

**N76-21663\*#** South Dakota State Univ., Brookings. Remote  
Sensing Inst.  
**INVESTIGATION OF REMOTE SENSING TECHNIQUES AS**  
**INPUTS TO OPERATIONAL RESOURCE MANAGEMENT**  
**MODELS Interim Report, 11 Dec. 1975 - 10 Mar. 1976**  
F. A. Schmer, Principal Investigator and R. E. Isakson Mar.  
1976 48 p refs Original contains imagery. Original photography  
may be purchased from the EROS Data Center, 10th and Dakota  
Avenue, Sioux Falls, S. D. 57198 ERTS  
(Contract NAS5-20982)  
(E76-10296; NASA-CR-146786; SDSU-RSI-76-01) Avail:  
NTIS HC \$4.00 CSCL 05A

**N76-21671#** Massachusetts Univ., Amherst. Water Resources  
Research Center.  
**MODELING THE DYNAMIC RESPONSE OF FLOOD PLAINS**  
**TO URBANIZATION IN SOUTHEASTERN NEW ENGLAND**  
Donald O. Doehring, Julius Gy Fabos, and Mark E. Smith Jun.  
1975 35 p refs  
(Contract D1-14-31-0001-5021)  
(PB-248407/9; Completion-FY-75-6; Pub-53; W76-02865;  
OWRT-A-074-MASS(1)) Avail: NTIS HC \$4.00 CSCL 08H

The relations between land use changes and flood expectan-  
cies in southeastern New England is examined. The common  
assumption that urbanization affects only floodplains related to  
low return period events is also evaluated with respect to this  
region. Watershed morphometry, surficial character, and land use  
were considered to be the most important independent variables  
which could be quantified. The dependent variable, an index of  
change in flood expectancy, is conceptualized as a response to  
land use change; morphometry and surficial character of a given  
basin are conceived as factors which condition the primary  
response. Mathematical models which were erected by multiple  
regression techniques are useful for predicting change in flood  
expectancies and account for more than 97% of the total  
variance. GRA

**N76-21746\*#** Bethune-Cookman Coll., Daytona Beach, Fla.  
**ENVIRONMENTAL MONITORING OF NORTH MERRITT**  
**ISLAND Annual Report, 1 Nov. 1974 - 31 Oct. 1975**  
P. Poonai 31 Oct. 1975 16 p refs  
(Grant NGR-10-022-001)  
(NASA-CR-146848) Avail: NTIS HC \$3.50 CSCL 13B

The environmental impact of the space shuttle operation on  
North Merritt Island was studied mainly by means of color infrared  
photos and field visits. An attempt was also made to generate  
character maps of the island using LANDSAT data with a view  
to decreasing the cost of monitoring and making the process  
more flexible in terms of rapid estimation of the extent of selected  
ground features. It seems possible that the IMAGE-100 output  
can be improved by using it in conjunction with software  
systems which are used for generating character maps. All the  
methods for generating maps show six main plant associations  
on North Merritt Island. It was shown that the six associations  
are related by ecological succession, merge into their neighbors  
in terms of component species and can be observed for changes  
in terms of component species. Author

**N76-21756#** Battelle Pacific Northwest Labs., Richland, Wash.  
**IN-SITU X-RAY FLUORESCENCE SYSTEM DESIGN**  
 H. G. Rieck, J. R. Kosorok, R. W. Perkins, and N. A. Wogman  
 Apr. 1975 13 p  
 (Contract AT(45-1)-1830)  
 (BNWL-B-394) Avail: NTIS HC \$5.45

The objective is to develop the capability for the real-time measurement of trace element and radionuclide pollutants in marine sediments. The technology discussed in this report permits the rapid mapping of the distribution of these pollutants in the surficial and bulk sediments. Author (NSA)

**N76-21772#** Science Applications, Inc., La Jolla, Calif.  
**APPLICATION OF REMOTE MONITORING TECHNIQUES IN AIR ENFORCEMENT**  
 C. B. Ludwig and M. Griggs Apr. 1975 180 p refs  
 (Contract EPA-68-03-2137)  
 (PB-247771/9; SAI-75-638-LJ; EPA-340/1-75-009) Avail: NTIS HC \$7.50 CSCL 14B

The usefulness of remote sensing techniques for routine field used by enforcement agencies are discussed taking into account the need for laser systems to comply with eye safety regulations. This study confirms that the technique of differential absorption has the best sensitivity for the single-ended measurement of gaseous pollutants. Data interpretation problems of the passive techniques make them less accurate in general, than the active methods. The legal aspects of enforcement monitoring are also investigated. GRA

**N76-21777#** North Dakota Water Resources Research Inst., Fargo.

**THE MICRODETERMINATION OF MERCURY SPECIES IN NATURAL WATER SYSTEMS BY LIQUID CHROMATOGRAPHY**

Richard J. Baltisberger Jan. 1975 62 p refs  
 (Contract DI-14-31-0001-3922)  
 (PB-248079/6; W1-222-010-75; OWRT-B-020-NOAK-2) Avail: NTIS HC \$4.50 CSCL 07D

Mercury in environmental water samples can exist in several cationic forms such as  $Hg(2+)$ ,  $Hg_2(2+)$  and  $CH_3Hg(+)$ . Two analytical techniques were developed and tested for (1) the measurement and differentiation of inorganic and organic mercury cations in environmental samples and (2) the separation by ion exchange, chromatographic means of these cations and their ultimate analysis by flameless atomic spectrophotometry. The first method is useful in the concentration range from 0.1 to 10 ppb  $Hg(2+)$ ,  $Hg_2(2+)$  or  $CH_3Hg(+)$ . The latter method is useful from 1 to 10 ppb mercury. GRA

**N76-21778#** Energy Resources Co., Inc., Cambridge, Mass.  
**A REVIEW OF CONCENTRATION TECHNIQUES FOR TRACE CHEMICALS IN THE ENVIRONMENT** Interim Report, Jul. 1974 - Feb. 1975

Nov. 1975 489 p refs  
 (Contract EPA-68-01-2925)  
 (PB-247946/7; EPA-560/7-75-002) Avail: NTIS HC \$12.50 CSCL 07D

This report contains a discussion of the techniques which are currently available for the concentration of trace pollutants prior to their analysis. Methods for the accumulation of metals and organic compounds from air, water, and solids are covered as well as a review of recent literature on bioaccumulation. Each section includes tables in which concentration methods, and the accumulated materials are listed along with the pertinent literature references. GRA

**N76-21840#** Lockheed Electronics Co., Houston, Tex. Aerospace Systems Div.  
**ESTIMATION OF DAILY MEAN AIR TEMPERATURE FROM SATELLITE DERIVED RADIOMETRIC DATA**  
 Dale Phinney Jan. 1976 75 p  
 (Contract NAS9-12200)

(NASA-CR-147517; LEC-7852; JSC-10920) Avail: NTIS HC \$4.50 CSCL 04B

The Screwworm Eradication Data System (SEDS) at JSC utilizes satellite derived estimates of daily mean air temperature (DMAT) to monitor the effect of temperature on screwworm populations. The performance of the SEDS screwworm growth potential predictions depends in large part upon the accuracy of the DMAT estimates. Author

**N76-21857#** National Environmental Satellite Service, Coral Gables, Fla. Satellite Field Services Station.  
**SAHARA DUST OVER THE ATLANTIC**  
 B. May Mayfield Nov. 1975 73 p refs  
 (PB-248452-11-3; NOAA-75120801-3) Avail: NTIS; Environmental Data Service, D762, Page Building 1, Room 400, Washington, D. C. 20235 CSCL 04B

A series of pictures is described of an area of dust that was photographed over the Atlantic and Caribbean area. These photographs were taken from geostationary satellites which are used to witness the evolution of weather systems over the oceans. Two mile resolution visible spectrum pictures are shown of an area of dust that had its origin over the Sahara Desert. GRA

**N76-21859#** Scripps Institution of Oceanography, San Diego, Calif. Visibility Lab.

**AN INSTRUMENT FOR THE MEASUREMENT OF SPECTRAL ATTENUATION COEFFICIENT AND NARROW ANGLE VOLUME SCATTERING FUNCTION OF OCEAN WATERS**  
 Final Report, Mar. 1973 - Jun. 1975

R. W. Austin and T. J. Petzold Sep. 1975 13 p Presented at the Ocean Optics Seminar of the Soc. of Photo-Optical Instrumentation Eng. Ann. Tech. Symp., 19 Aug. 1975  
 (Contract N66857-73-C-0146; ARPA Order 2431)  
 (AD-A017878; SIO-Ref-75-25) Avail: NTIS CSCL 08/10

A new instrument has been developed for the study of those optical properties of ocean water that affect the transmission of image-forming light. The instrument performs simultaneous measurements of the volume attenuation coefficient and the volume scattering function at three angles. Any of ten wavelengths covering the spectral range from 400 to 670 nanometers may be used. A depth capability of 500 meters permits the examination of water below the euphotic zone and the bottom waters on the continental shelf. The considerations leading to the design of the instrument, its capabilities and the unique features it incorporates are discussed. Some examples of the data obtained with the instrument are presented. GRA

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# GEODESY AND CARTOGRAPHY

Includes mapping and topography.

**A76-19634 #** Optimization of three-dimensional terrestrial networks. L. Hradilek (Karlova Universita, Prague, Czechoslovakia). *Studia Geophysica et Geodaetica*, vol. 19, no. 3, 1975, p. 210-216. 9 refs.

The least-squares adjustment method is used for the optimal layout of a three-dimensional geodetic network and the design of observations. A mathematical model for the parametric adjustment is given by the observation equations for horizontal direction, spatial distance, zenith distance and elevation difference. A transformation is presented for observables and their variances. The optimization procedure can be applied to satellite tracking networks and celestial geodesy. B.J.

**A76-19689 #** Comparison of procedures for direct determination of geodetic directional azimuth from astronomical observations (O sravnenii sposobov neposredstvennogo opredeleniia geodezicheskogo azimuta napravleniia iz astronomicheskikh nabludenii). A. N. Kuznetsov (Moskovskii Institut Inzhenerov Geodezii, Aerofotos'emki i Kartografii, Moscow, USSR). *Geodeziia i Aerofotos'emka*, no. 2, 1975, p. 61-65. In Russian.

Procedures for determining geodetic azimuth directly from astronomical observations are compared theoretically. It is shown that the fundamental error in these determinations is associated with measurement of the angle between a star and a terrestrial object. Preference is given to azimuth determinations from observations of stars on the vertical of a terrestrial object since, in this case, the angle between the star and the object can be measured with the greatest accuracy. F.G.M.

**A76-23686 #** Determining the coordinates of points of a region by television images (Opredelenie koordinat tochek mestnosti po televizionnym izobrazheniiam). E. A. Melina. *Geodeziia i Aerofotos'emka*, no. 1, 1975, p. 101-105. In Russian.

The paper discusses the general principles and basic relations of the two main methods for determining the coordinates of points in a given region from its television image: the analytic method and the method of projective grids. The analytic method consists in a single resection to determine the elements of the exterior orientation of the image, followed by the determination of the geodetic coordinates of the points of the region via regular determination of orientation. The method of projective grids consists in plotting onto a map the points of the region identified in the TV image by visually transferring the images of these points with the aid of two projectively corresponding grids - the photo grid and the map grid. P.T.H.

**N76-16517\*#** Bureau of Mineral Resources, Geology and Geophysics, Canberra (Australia).

**MAPPING ISLANDS, REEFS AND SHOALS IN THE OCEANS SURROUNDING AUSTRALIA** Quarterly Report, 8 Aug. - 8 Nov. 1975

Leonard G. Turner, Principal Investigator 8 Nov. 1975 4 p  
Sponsored by NASA ERTS  
(E76-10094; NASA-CR-145997; QR-1) Avail: NTIS HC \$3.50 CSCL 08B

The author has identified the following significant results. Comparisons of the imagery with aerial photography of areas of reefs and island and with 1:250,000 maps of coastlines indicate that the MSS imagery depicts detail to an extent which is satisfactory for 1:250,000 mapping. As the imagery does not have some of the disadvantages of aerial photography, the former should be valuable for mapping reefs, islands, and shoals. The water discoloration problem is significant as the discolored water

appears to occur near shallow depths, so that confusion could arise through the misinterpretation of discolored water, when it exists, as shallow water.

**N76-16554\*#** Dartmouth Coll., Hanover, N.H.

**AN INVESTIGATION OF THERMAL ANOMALIES IN THE CENTRAL AMERICAN VOLCANIC CHAIN AND EVALUATION OF THE UTILITY OF THERMAL ANOMALY MONITORING IN THE PREDICTION OF VOLCANIC ERUPTIONS** Final Report

Richard E. Stoiber, Principal Investigator and William I. Rose, Jr. (Michigan Technological Univ.) Jul. 1975 81 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 EREP

(Contract NAS9-13311; Grant NSF GA-26026)

(E76-10132; NASA-CR-144496) Avail: NTIS HC \$5.00 CSCL 08F

The author has identified the following significant results. Ground truth data collection proves that significant anomalies exist at 13 volcanoes within the test site of Central America. The dimensions and temperature contrast of these ten anomalies are large enough to be detected by the Skylab 192 instrument. The dimensions and intensity of thermal anomalies have changed at most of these volcanoes during the Skylab mission.

**N76-17675\*#** Agnew Tech-Tran, Inc., Woodland Hills, Calif.  
**NEOTECTONIC TRANSVERSE STRUCTURES OF THE TYAN-SHAN AND THEIR MANIFESTATION ON SPACE PHOTOGRAPHS**

V. I. Makorov and L. I. Solovyeva Washington NASA Feb. 1976 16 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Geol. i Razvedka (Moscow), no. 2, 1975 p 10-18

(Contract NASw-2789)

(NASA-TT-F-16851) HC \$3.50 CSCL 08E

The structural and geomorphological analysis of the Tyan-Shan relief in conjunction with the deciphering of space photographs has shown almost identical value of closely conjugated longitudinal and cutting directions which were similarly evident in the morphology of fold and boulder structural forms and rupture disturbances of different order from planetary to local. However, in different Tyan-Shan areas or within one area but in different stages of the tectonic development, these directions were manifested in such a way that one of them was the main direction and others were secondary and formed structural details. But in all the combinations, often varying in time, they have inevitably accompanied each other and are closely connected genetically. Author

**N76-17686\*#** National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

**GRAVIMETRIC INVESTIGATIONS ON THE NORTH AMERICAN DATUM (1972 - 1973)**

R. S. Mather Dec. 1975 89 p refs Submitted for publication

(NASA-TM-X-71058; X-921-75-244) Avail: NTIS HC \$5.00 CSCL 08N

All the available unclassified gravity data on the North American Datum (NAD) and in the surrounding oceans was assembled late in 1972 for the investigation of the gravity field in North America and its relation to North American Datum 1927 (NAD 27). The gravity data in Canada and the United States was compiled on a common datum compatible with the International Gravity Standardization Network 1971 (IGSN 71). The variation in the error of representation in the region is studied along with the correlation characteristics of gravity anomalies with elevation. A free air geoid (FAG 73) was computed from a combination of surface gravity data and Goddard Earth Model (GEM) 4 and this was used as the basis for the computation of the non-Stokesian contributions to the height anomaly. The geocentric orientation parameters obtained by this astrogravimetric method are compared with those obtained by satellite techniques.

### 03 GEODESY AND CARTOGRAPHY

The differences are found to be no greater than those between individual satellite solutions. The differences between the astrogravimetric solution and satellite solutions GSFC 73 and GEM 6 are studied in detail with a view to obtaining a better understanding of these discrepancies. Author

**N76-19518\*#** Bechtold Satellite Technology Corp., City of Industry, Calif.

#### **AN EVALUATION OF SKYLAB (EREP) REMOTE SENSING TECHNIQUES APPLIED TO INVESTIGATIONS OF CRUSTAL STRUCTURE Final Report**

Ira C. Bechtold, Principal Investigator, J. T. Reynolds, R. L. Archer, and C. G. Wagner Dec. 1975 306 p refs Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 EREP

(Contract NAS9-14235)

(E76-10215; NASA-CR-147458; BESTEC-101-F-12/75) Avail: NTIS HC \$9.75 CSDL 08G

The author has identified the following significant results. Film positives (70mm) from all six S190A multispectral photographic camera stations for any one scene can be registered and analyzed in a color additive viewer. Using a multispectral viewer, S190A and B films can be projected directly onto published geologic and topographic maps at scales as large as 1:62,500 and 1:24,000 without significant loss of detail. S190A films and prints permit the detection of faults, fractures, and other linear features not visible in any other space imagery. S192 MSS imagery can be useful for rock-type discrimination studies and delineation of linear patterns and arcuate anomalies. Anomalous color, reflectances and arcuate color patterns revealed mineralized zones, copper deposits, vegetation, and volcanic rocks in various locations such as Panamint Range (CA), Greenwater (Death Valley), Lava Mountains (CA), northwestern Arizona, and Coso Hot Springs (CA).

**N76-19530\*#** Ohio State Univ. Research Foundation, Columbus. Dept. of Geodetic Science.

#### **SOME PROBLEMS CONCERNED WITH THE GEODETIC USE OF HIGH PRECISION ALTIMETER DATA**

D. Lelgemann Jan. 1976 67 p refs

(Grant NGR-36-008-161; OSURF Proj. 3210)

(NASA-CR-146302; Rept-237) Avail: NTIS HC \$4.50 CSDL 08E

The definition of the geoid in view of different height systems is discussed. A definition is suggested which makes it possible to take into account the influence of the unknown corrections to the various height systems on the solution of Stokes' problem. A solution to Stokes' problem with an accuracy of 10 cm is derived which allows the inclusion of the results of satellite geodesy. In addition equations are developed for the determination of spherical harmonies using altimeter measurements. The influence of the ellipticity of the reference surface is considered. Author

**N76-20570\*** Ohio State Univ. Research Foundation, Columbus. **THE GEOID: DEFINITION AND DETERMINATION**

Richard H. Rapp In its Proc. of the Geodesy/Solid Earth and Ocean Phys. (GEOP) Res. Conf. Sep. 1975 p 69-77 refs Repr. from Conf. Proc. E(Earth)S, v. 55, no. 3, Mar. 1974

CSDL 08E

The principles and problems relative to the determination of the geoid are outlined. Factors discussed include: gravity data requirements for a precise geoid; mean sea level; and satellite altimetry. It is indicated that geoid undulations can be determined on a global basis to plus or minus 3 m. Application of geoid information to oceanography and the determination of sea surface topography considered. J.M.S.

**N76-20747\*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

#### **IMPROVEMENT IN THE GEOPOTENTIAL DERIVED FROM**

#### **SATELLITE AND SURFACE DATA (GEM 7 AND 8)**

C. A. Wagner, F. J. Lerch, J. E. Brown (Computer Sci. Corp., Silver Spring, Md.), and J. A. Richardson (Computer Sci. Corp., Silver Spring, Md.) Jan. 1976 13 p refs Submitted for publication (NASA-TM-X-71088; X-921-76-20) Avail: NTIS HC \$3.50 CSDL 08N

A refinement was obtained in the earth's gravitational field using satellite and surface data. In addition to a more complete treatment of data previously employed on 27 satellites, the new satellite solution (Goddard Earth Model 7) includes 64,000 laser measurements taken on 7 satellites during the international satellite geodesy experiment (ISAGEX) program. The GEM 7, containing 400 harmonic terms, is complete through degree and order 16. The companion solution GEM 8 combines the same satellite data as in GEM 7 with surface gravimetry over 39% of the earth. The GEM 8 is complete to degree and order 25. Extensive tests on data independent of the solution show that the undulation of the geoidal surface computed by GEM 7 has an accuracy of about 3m (rms). The overall accuracy of the geoid estimated by GEM 8 is estimated to be about 4-1/4m (rms), an improvement of almost 1m over previous solutions. Author

**N76-20759#** RAND Corp., Santa Monica, Calif.

#### **A NEW (REVISED) TABULATION OF THE SCRIPPS TOPOGRAPHY ON A 1 DEGREE GLOBAL GRID. PART 1: TERRAIN HEIGHTS**

W. L. Gates and A. B. Nelson Oct. 1975 139 p refs

(Contract DAHC15-73-C-0181; ARPA Order 189-1)

(AD-A017560) Avail: NTIS CSDL 08/6

A revision and retabulation of world-wide terrain height data originally prepared at the Scripps Institution of Oceanography is presented. Revisions to the original data include the insertion of the elevation of the surface of lakes, the negative elevation of land areas lying below sea level, and the elevation of heretofore omitted islands. A number of errors have also been corrected, and changes made in the land elevation near coasts. The newly formatted global 1-deg tabulations of terrain data are supplemented by a global analysis, frequency histograms, and zonal averages. GRA

**N76-21825#** Ohio State Univ., Columbus. Dept. of Geodetic Science.

#### **EXTERNAL GRAVITY POTENTIAL OF THE EARTH, GRAVIMETRIC QUANTITIES AND GEODETIC PARAMETERS AFFECTED BY GRAVITY Final Report. 1 Jan. 1972 - 30 Jun. 1975**

Urho A. Uotila Aug. 1975 47 p refs

(Contract F19628-72-C-0120; AF Proj. 8607)

(AD-A016491; DGS-229; AFCRL-TR-75-0431) Avail: NTIS CSDL 08/5

Subject matter includes such items as the use of gravity gradient measurements, the convergence problems in physical geodesy, least-squares collocation theory and applications, combination of satellite and gravimetry data, inversion of large symmetric matrices, covariance functions, anomaly degree variances, mass distribution in the earth's interior, role of altimeter data in the determination of mean gravity anomalies, refinement of modeling techniques for the determination of geopotential coefficients and computational techniques in gravimetry. Suggestions for further studies are made. GRA

## GEOLOGY AND MINERAL RESOURCES

Includes mineral deposits, petroleum deposits, spectral properties of rocks, geological exploration, and lithology.

**A76-19329 \*** Skylab explores the earth. V. R. Wilmarth, J. L. Kaltenbach, W. B. Lenoir, and M. C. McEwen (NASA, Johnson Space Center, Houston, Tex.). *Annual Highway Geology Symposium, Boise, Idaho, Aug. 13-15, 1975, Paper. 14 p.* 5 refs.

During the third manned mission on Skylab, an experiment was conducted by the crewmen to determine what type of earth survey information man could obtain through visual observations and by handheld cameras. More than 850 observations and 2000 photographs were taken for 16 different scientific disciplines. Observations and photographs were taken over the entire range of possible sun angles (twilight to local noon) and viewing angles (high oblique to vertical). Results of the experiment confirm that man's ability to recognize objects and patterns, to integrate his observations over a range of aspects and lighting angles, to reason, and to make selective observations, can bring another dimension to the study of the earth.

(Author)

**A76-19583** Multiscale aerial and orbital techniques for management of coal-mined lands. F. J. Wobber (IBM Corp., Gaithersburg, Md.), O. R. Russell, and D. J. Deely (Earth Satellite Corp., Bethesda, Md.). *Photogrammetria*, vol. 31, Oct. 1975, p. 117-133. 10 refs.

The expansion of surface coal mining to meet the world's energy needs must include preplanning for environmental protection and the monitoring of reclamation progress. Due to the rapid changes in rates of mining, grading, and revegetating mined lands, the flexibility provided by satellite and multilevel aircraft inventory and monitoring systems is required. LANDSAT-1 imagery and small-scale color-infrared aerial photography have unique advantages for performing a rapid regional inventory of disturbances in coal-mining areas, and have immediate cost benefits for regulatory agencies and the mining industry. Large-scale photography is needed for comprehensive studies of acid mine drainage, and other mining-related water-quality control problems. A systematic analysis of nearly 50 mined-land features versus various scales of imagery has been tabulated for ease of reference by those involved in mined-land studies. (Author)

**A76-23550 \* #** Exploration for porphyry copper deposits in Pakistan using digital processing of Landsat-1 data. R. G. Schmidt. *U.S. Geological Survey, Journal of Research*, vol. 4, Jan.-Feb. 1976, p. 27-34. 6 refs. NASA-supported research.

Rock-type classification by digital-computer processing of Landsat-1 multispectral scanner data has been used to select 23 prospecting targets in the Chagai District, Pakistan, five of which have proved to be large areas of hydrothermally altered porphyry containing pyrite. Empirical maximum and minimum apparent reflectance limits were selected for each multispectral scanner band in each rock type classified, and a relatively unrefined classification table was prepared. Where the values for all four bands fitted within the limits designated for a particular class, a symbol for the presumed rock type was printed by the computer at the appropriate location. Drainage channels, areas of mineralized quartz diorite, areas of pyrite-rich rock, and the approximate limit of propylitic alteration were very well delineated on the computer-generated map of the test area. The classification method was used to evaluate 2,100 sq km in the Mashki Chah region. The results of the experiment show that outcrops of hydrothermally altered and mineralized rock can be identified from Landsat-1 data under favorable conditions. (Author)

**A76-24256 \*** Stream pattern analysis using optical processing of ERTS imagery of Kansas. J. McCauley, D. Egbert, J. McNaughton, and F. T. Ulaby (University of Kansas for Research Inc., Lawrence, Kan.). *Modern Geology*, vol. 5, Nov. 1975, p. 127-142. 9 refs. Contract No. NAS5-21822.

A spatial frequency analysis was carried out to obtain large-scale geologic and other ground pattern spatial frequency and orientational data from an optical data processing system using Earth Resources Technology Satellite-1 (ERTS-1) imagery of Kansas as input. The Diffraction Pattern Sampling Unit (DPSU) of the optical data processing system consists of a photodiode array containing 32 wedge-shaped photodiodes and 32 annular ring diodes. The curve obtained from the intensity distribution of the frequency spectrum yielded by the ring diodes gives the spatial frequency contributions due to ground features on the image. The curve obtained from the wedge-shaped diodes indicates the orientation of features in the sample area. Ten sample sites were used for each of eight geologic-physiographic regions. Comparison of ERTS-1 images with their respective spatial frequency and orientational curves reveals that preferred orientations of drainage produce recognizable peaks.

C.K.D.

**A76-25435 \*** Geologic mapping using LANDSAT data. B. S. Siegal and M. J. Abrams (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.). *Photogrammetric Engineering and Remote Sensing*, vol. 42, Mar. 1976, p. 325-331, 333-337. 18 refs. Contract No. NAS7-100.

The feasibility of automated classification for lithologic mapping with LANDSAT digital data was evaluated using three classification algorithms. The two supervised algorithms analyzed; a linear discriminant analysis algorithm and a hybrid algorithm which incorporated the Parallelepiped algorithm and the Bayesian maximum likelihood function, were comparable in terms of accuracy; however, classification was only 50 per cent accurate. The linear discriminant analysis algorithm was three times as efficient as the hybrid approach. The unsupervised classification technique, which incorporated the CLUS algorithm, delineated the major lithologic boundaries and, in general, correctly classified the most prominent geologic units. The unsupervised algorithm was not as efficient nor as accurate as the supervised algorithms. Analysis of spectral data for the lithologic units in the 0.4 to 2.5 microns region indicated that a greater separability of the spectral signatures could be obtained using wavelength bands outside the region sensed by LANDSAT. (Author)

**A76-27110** Using the natural-frequency concept in remote probing of the earth. R. J. Lytle and D. L. Lager (California, University, Livermore, Calif.). *Radio Science*, vol. 11, Mar. 1976, p. 199-209. 15 refs. Research supported by the U.S. Bureau of Mines; Contract No. W-7405-eng-48.

A technique is given for determining the thicknesses and the electrical constitutive parameters of a planar-layered medium such as a coal seam in a mine environment. Time-domain experimental data are analyzed with Prony's method to determine the natural frequencies of the layered medium. Explicit relations are given (for dielectric layers) for determining the thicknesses and dielectric constants from the experimentally determined natural frequency results. Explicit expressions are also given (for conductive layers) for calculating the electrical thickness from natural frequency results. The method is illustrated with sample numerical results. (Author)

**A76-27112** Theory of electromagnetic scattering from a layered medium with a laterally varying substrate. J. R. Wait (Cooperative Institute for Research in Environmental Sciences, Boulder, Colo.) and D. C. Chang (Colorado, University, Boulder, Colo.). *Radio Science*, vol. 11, Mar. 1976, p. 221-229. 11 refs. Research sponsored by the U.S. Bureau of Mines.

An analysis is given for scattering of a plane wave from a two-layer conducting medium where the upper layer is homogeneous but where the lower layer or substrate is characterized by a



## 04 GEOLOGY AND MINERAL RESOURCES

periodically varying surface impedance. The exact solution obtained is expressed in terms of continued fraction expansions that converge rapidly for most cases of physical interest. The motivation was to provide understanding of how electromagnetic waves can be used to determine the thickness of a layer of coal that is backed by a relatively highly conducting region of slate. It is shown that, if the slate varies sufficiently slowly in the horizontal direction, the observed surface impedance and wave tilt at the air/coal interface is related directly to the local properties at the point of measurement.

(Author)

**A76-28053 \*** Geomorphic interpretation of Skylab photography collected over the Nevada portion of the Great Basin. J. B. Frater and W. N. Melhorn (Purdue University, West Lafayette, Ind.). In: Remote sensing of earth resources, Volume 4 - Proceedings of the Fourth Annual Conference on Earth Resources, Tullahoma, Tenn., March 24-26, 1975. Tullahoma, University of Tennessee, 1975, p. 21-42. 15 refs. Contract No. NAS9-13274.

Skylab S190B black and white photography has a useful reconnaissance capability in geomorphic mapping of landform features in the arid and semi-arid Great Basin. Enlargement of original photographic data products to a scale of 1:250,000 scale compatible with published topographic maps permits ready identification and classification of most landform elements. However, interpretation suffers through the lack of stereoscopic coverage and introduces problems relating to scale and loss of detail. When aircraft underflight photography for the same area is used as a data enhancement tool, problems of scale, detail, and interpretation are diminished. The combination of orbital and underflight photographic coverage provides a regional overview in which the interrelationships of both micro- and macro-scale landforms become apparent. (Author)

**N76-16522\*#** Geological Survey, Denver, Colo. Office of Energy Resources.

**LANDSAT STUDY OF ALTERATION AUREOLES IN SURFACE ROCKS OVERLYING PETROLEUM DEPOSITS** Progress Report

T. J. Donovan, Principal Investigator 7 Nov. 1975 5 p refs Sponsored by NASA ERTS (E76-10099; NASA-CR-146032) Avail: NTIS HC \$3.50 CSCL 08G

The author has identified the following significant results. A series of low altitude underflight remote sensing experiments were flown at Cement and Davenport oil fields, Oklahoma. An experimental algorithm which employs a sinusoidal stretch of brightness values was developed and applied to a January 1973 scene (bands 4, 5, and 6) of Cement. The results, although not spectacular, are extremely encouraging and for the first time demonstrate that the alteration anomaly at Cement may be defined through enhanced LANDSAT images.

**N76-16526\*#** California Earth Science Corp., Santa Monica. **FAULT TECTONICS AND EARTHQUAKE HAZARDS IN THE PENINSULAR RANGES, SOUTHERN CALIFORNIA** Monthly Progress Report, Dec. 1975

Paul M. Merifield, Principal Investigator Dec. 1975 2 p ref EREP

(Contract NAS2-7698)

(E76-10103; NASA-CR-146036; MPR-31) Avail: NTIS HC \$3.50 CSCL 08E

**N76-16534\*#** California Earth Science Corp., Santa Monica. **FAULT TECTONICS AND EARTHQUAKE HAZARDS IN THE PENINSULAR RANGES, SOUTHERN CALIFORNIA** Monthly Progress Report, Nov. 1975

Paul M. Merifield, Principal Investigator Nov. 1975 2 p refs EREP

(Contract NAS2-7698)

(E76-10111; NASA-CR-146044; MPR-30) Avail: NTIS HC \$3.50 CSCL 08G

**N76-16725#** Woods Hole Oceanographic Institution, Mass. **THE CONTINENTAL MARGIN OFF WESTERN AFRICA: ANGOLA TO SIERRA LEONE**

K. O. Emery, Elazar Uchupi, Joseph Phillips, and Carl Bowin Dec. 1974 159 p refs

(Grant NSF GX-28193)

(PB-245408/O; WHOI-74-99; NSF/IDOE-75-54) Avail: NTIS HC \$6.75 CSCL 08J

About 30,750 line km of geophysical traverses (seismic reflection and refraction, magnetics, and gravity) were made in the Gulf of Guinea and vicinity aboard R/V ATLANTIS II during 1972 and 1973. These traverses, supplemented by about 50,000 line km of previous ones by other ships, provide a basis for mapping and understanding the geological structure, history and origin of the region. The deep indentation of the outline of western Africa is paralleled by a similar bend of the Mid-Atlantic Ridge, and by the prominent bulge of northeastern Brazil. These sharp bends are due to left-lateral offsets by numerous transform faults in a belt of equatorial fracture zones. GRA

**N76-17450\*#** New Mexico State Bureau of Mines and Mineral Resources, Socorro.

**EARTH RESOURCES EVALUATION FOR NEW MEXICO BY LANDSAT-2** Progress Report, 1 Sep. - 30 Nov. 1975

David E. Tabet, Principal Investigator, Frank E. Kottowski, Michael H. Inglis, Linda L. Love, and Stanley A. Morain 30 Nov. 1975 5 p refs ERTS

(Contract NAS5-20916)

(E76-10141; NASA-CR-146150) Avail: NTIS HC \$3.50 CSCL 08B

**N76-17452\*#** Geological Survey, Reston, Va.

**DETECTION AND MAPPING OF MINERALIZED AREAS IN THE CORTEZ-UINTA BELT, UTAH-NEVADA, USING COMPUTER-ENHANCED ERTS IMAGERY** Progress Report Lawrence C. Rowan, Principal Investigator 15 Jan. 1976 6 p ref ERTS

(E76-10143; NASA-CR-146152) Avail: NTIS HC \$3.50 CSCL 08B

The author has identified the following significant results. Preliminary analysis indicates that mineralogical differences between altered rocks and most unaltered rocks in south-central Nevada cause visible and near infrared spectral reflectance differences, which can be used to discriminate these broad categories of rocks in multispectral images. The most important mineralogical differences are the increased abundance of goethite, hematite, and jarosite, and the presence of alunite, montmorillonite, and kaolinite in the altered rock. The technique to enhance subtle spectral differences combines ratioing of the MSS bands and contrast stretching. The stretched ratio values are used to produce black and white images that depict materials according to spectral reflectance; ratioing minimizes the influence of topography and overall albedo on the grouping of spectrally similar materials. Field evaluation of color-ratio composite shows that, excluding alluvial areas, approximately 80 percent of the green and brown color patterns are related to hydrothermal alteration. The remaining 20 percent consists mainly of pink hematitic crystallized tuff, a result of vapor phase crystallization, and of tan and red ferruginous shale and siltstone.

**N76-17459\*#** Earth Satellite Corp., Washington, D.C.

**APPLICATION OF LANDSAT-2 DATA TO THE IMPLEMENTATION AND ENFORCEMENT OF THE PENNSYLVANIA SURFACE MINING CONSERVATION AND RECLAMATION ACT** Progress Report, 19 Sep. - 19 Dec. 1975

Daniel J. Deely, Principal Investigator 19 Dec. 1975 10 p ERTS

(Contract NAS5-21998)

(E76-10150; NASA-CR-146159; C-1037-2-3) Avail: NTIS HC \$3.50 CSCL 08I

**N76-17462\*#** Environmental Research Inst. of Michigan, Ann Arbor. Infrared and Optics Div.

**ASSESSMENT OF MAPPING EXPOSED FERROUS AND FERRIC IRON COMPOUNDS USING SKYLAB-EREP DATA Final Report, 8 Mar. 1973 - 30 Aug. 1975**

R. Vincent, Principal Investigator, H. Wagner, W. Pillars, and C. Bennett Jan. 1976 65 p refs Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 EREP

(Contract NAS9-13317)

(E76-10153; NASA-CR-144504; ERIM-102000-42-F) Avail: NTIS HC \$4.50 CSCL 08G

The author has identified the following significant results. The S190B color photography is as useful as LANDSAT data for the mapping of color differences in the rocks and soils of the terrain. An S192 ratio of 0.79 - 0.89 and 0.93 - 1.05 micron bands produced an apparently successful delineation of ferrous, ferric, and other materials, in agreement with theory and ratio code studies. From an analysis of S191 data, basalt and dacite were separated on the basis of differences in spectral emissivity in the 8.3 - 12 micron region.

**N76-17492\*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

**LANDSAT INVENTORY OF SURFACE-MINED AREAS USING EXTENDIBLE DIGITAL TECHNIQUES**

Arthur T. Anderson, Dorothy T. Schultz (Gen. Elec. Co., Beltsville, Md.), and Ned Buchman (Gen. Elec. Co., Beltsville, Md.) In NASA. Lyndon B. Johnson Space Center NASA Earth Resources Survey Symp. Vol. 1-A: Agr., Environment Jun. 1975 p 329-345 refs

(E-7) CSCL 08I

Multispectral LANDSAT imagery was analyzed to provide a rapid and accurate means of identification, classification, and measurement of strip-mined surfaces in Western Maryland. Four band analysis allows distinction of a variety of strip-mine associated classes, but has limited extendibility. A method for surface area measurements of strip mines, which is both geographically and temporally extendible, has been developed using band-ratioed LANDSAT reflectance data. The accuracy of area measurement by this method, averaged over three LANDSAT scenes taken between September 1972 and July 1974, is greater than 93%. Total affected acreage of large (50 hectare/124 acre) mines can be measured to within 1.0%. Author

**N76-17501\*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

**NASA EARTH RESOURCES SURVEY SYMPOSIUM. VOLUME 1-B: GEOLOGY, INFORMATION SYSTEMS AND SERVICES First Comprehensive Symposium on the Practical Application of Earth Resources Survey Data**

Jun. 1975 893 p refs Symp. held at Houston, Tex., 9-12 Jun. 1975 See also Vol. 1-A N76-17469; Vol. 1-C N76-17552; Vol. 1-D N76-175 ; Vol. 3 N76-17613; Original contains color imagery. Original NASA photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198

(NASA-TM-X-58168-Vol-1-B; JSC-09930-Vol-1-B) Avail: NTIS HC \$7.25 CSCL 05B

A symposium was conducted on the practical applications of earth resources survey technology including utilization and results of data from programs involving LANDSAT, the Skylab earth resources experiment package, and aircraft. Topics discussed include geological structure, landform surveys, energy and extractive resources, and information systems and services.

**N76-17503\*** Chevron Overseas Petroleum, Inc., San Francisco, Calif.

**LANDSAT IMAGE STUDIES AS APPLIED TO PETROLEUM EXPLORATION IN KENYA**

John B. Miller In NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 605-624 refs

(G-2) CSCL 08G

The Chevron-Kenya oil license, acquired in 1972, covers an area at the north end of the Lamu Embayment. Immediately after acquisition, a photogeologic study of the area was made followed by a short field inspection. An interpretation of LANDSAT-1 images as a separate attempt to improve geological knowledge was completed. The method used in the image study, the multispectral characteristics of rock units and terrain, and the observed anomalous features as seen in the LANDSAT imagery are described. It was found that the study helped to define the relationship of the Lamu Embayment and its internal structure with surrounding regional features, such as the East Africa rifting, the Rudolf Trough, the Bur Acaba structural ridge, and the Ogaden Basin. Author

**N76-17504\*** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. **DETECTABILITY OF GEOTHERMAL AREAS USING SKYLAB X-5 DATA**

Barry S. Siegal, Anne B. Kahle, Alexander F. H. Goetz, Alan R. Gillespie, and Michael J. Abrams In NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp. Vol. 1-B Jun. 1975 p 625-640 refs

(G-3) CSCL 08G

The results are presented of a study which was undertaken to determine if data from a single near-noon pass of Skylab could be used to detect geothermal areas. The size and temperature requirements for a geothermally heated area to be seen by Skylab S-192 MSS X-5 thermal sensor were calculated. This sensor obtained thermal data with the highest spatial resolution of any nonmilitary satellite system. Only very large hot areas could be expected to be unambiguously recognized with a single data set from this instrument. The study area chosen was The Geysers geothermal field in Sonoma County, California, the only geothermal area of significant size scanned by Skylab. Unfortunately, 95% of the Skylab thermal channel data was acquired within 3 hours of local noon. For The Geysers area only daytime X-5 data were available. An analysis of the thermal channel data (10.2 to 12.5  $\mu$ m) revealed that ground temperatures determined by Skylab were normally distributed. No anomalous hot spots were apparent. Computer enhancement techniques were used to delineate the hottest 100 and 300 ground areas (pixel, 75 m by 75 m) within the study region. It was found that the Skylab MSS with the X-5 thermal detector does not have sufficient spatial resolution to locate unambiguously from daytime data any but the largest and hottest convectively created geothermal features, which in general are prominent enough to have been previously recognized. Author

**N76-17506\*** Bechtold Satellite Technology Corp., City of Industry, Calif.

**APPLICATION OF SKYLAB IMAGERY TO RESOURCE EXPLORATION IN THE DEATH VALLEY REGION**

Ira C. Bechtold, John T. Reynolds, and C. Gregory Wagner In NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 665-672 refs

(G-7) CSCL 08F

The Hunter Mountain plateau in the northern Panamint Range, California, exhibits anomalous topographic, vegetative, color and structural features in Skylab and LANDSAT satellite images which have strong correlation with mineralized areas and should prove significant for future exploration. Data observed, to date were studied with reference to published geology and is interpreted in terms of greatest probability of ore mineralization. Further study in conjunction with space imagery analysis is recommended for location of potential mineral zones. Author

**N76-17508\*** Colorado School of Mines, Golden. Geology Dept.

**GEOLOGICAL SIGNIFICANCE OF FEATURES OBSERVED IN COLORADO FROM ORBITAL ALTITUDES**

Don L. Sawatzky, Gary Prost, Keenan Lee, and D. H. Knepper In NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 713-760 refs

## 04 GEOLOGY AND MINERAL RESOURCES

(G-10) CSCL 08G

Three major investigations using LANDSAT and Skylab imagery concerned with analyses of color anomalies and linear features of central Colorado are discussed. The studies conducted are concerned with the geological significance of spectral and spatial features on the images. Color anomalies in Skylab photographs were analyzed and evaluated for locating indicators of mineralization. The relationships were determined of all linear features in a LANDSAT image to the rock joint systems and the detectable larger geologic structures; techniques for extracting that geologic information are indicated. Some anomalous megalinear features in LANDSAT and Skylab images are analyzed which transect major structures and, their associated geologic features are described. Author

**N76-17511\*** California Earth Science Corp., Santa Monica.  
**ACTIVE AND INACTIVE FAULTS IN SOUTHERN CALIFORNIA VIEWED FROM SKYLAB**

P. M. Merifield and D. L. Lamar / In NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 779-797 refs

CSCL 08B

The application is discussed of Skylab imagery along with larger scale photography and field investigations in preparing fault maps of California for use in land use planning. The images were used to assist in distinguishing active from inactive faults (by recognizing indications of recent displacement), determining the length of potentially active faults, identifying previously unmapped faults, and gaining additional information on regional tectonic history. Author

**N76-17517\*** Institut Francais du Petrole, Rueil-Malmaison.  
**CREATING A SYSTEM FOR THE GEOLOGICAL EXPLOITATION OF SATELLITE IMAGES: AUTOMATIC MAPPING AND GEOPHYSICAL DATA COMPARISON**

S. Braconne, M. Cavalier, M. Dubesset, J. Guillemot, and M. Guy / In NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 905-931 refs

(G-20) CSCL 08G

A method is presented for integrating satellite images into a geophysical data interpretation system. Aspects of the method include: an attempt to automatically interpret images by structural, mainly topological, methods for the mapping of geological contours; an analysis of the position relation of the contours gives a skeleton stratigraphy (order of succession); and a system combining some of the extracted elements with geographic data to make an objective search for an interpretation hypothesis. Some examples are presented. Author

**N76-17518\*** Pennsylvania State Univ., University Park. Office for Remote Sensing of Earth Resources.

**APPLICATION OF SATELLITE PHOTOGRAPHIC AND MSS DATA TO SELECTED GEOLOGIC AND NATURAL RESOURCE PROBLEMS IN PENNSYLVANIA. 1: LINEAMENTS AND MINERAL OCCURRENCES IN PENNSYLVANIA. 2: RELATION OF LINEAMENTS TO SULFIDE DEPOSITS: BALD EAGLE MOUNTAIN, CENTRE COUNTY, PENNSYLVANIA. 3: COMPARISON OF SKYLAB AND LANDSAT LINEAMENTS WITH JOINT ORIENTATIONS IN NORTH CENTRAL PENNSYLVANIA**

W. S. Kowalik, D. P. Gold, and M. Dennis Krohn / In NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 933-969 refs

(Contracts NAS9-13406; NAS5-23133)

(G-21) CSCL 08G

Those metallic mineral occurrences in Pennsylvania are reported which lie near lineaments mapped from LANDSAT-1 satellite imagery and verified from Skylab photography where available. The lineaments were categorized by degree of expression and type of expression; the mineral occurrences were classified

by host rock age, mineralization type, and value. The accompanying tables and figure document the mineral occurrences geographically associated with lineaments and serve as a base for a mineral exploration model. Author

**N76-17519\*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

**GEOLOGICAL MAPPING IN NORTHWESTERN SAUDI ARABIA USING LANDSAT MULTISPECTRAL TECHNIQUES**

H. W. Blodgett, G. F. Brown (Geological Surv., Reston, Va.), and J. G. Moik (Computer Sciences Corp., Silver Spring, Md.) / In its NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 971-989 refs

(G-22) CSCL 08G

Various computer enhancement and data extraction systems using LANDSAT data were assessed and used to complement a continuing geologic mapping program. Interactive digital classification techniques using both the maximum-likelihood and thresholding statistical approaches achieve very limited success in areas of highly dissected terrain. Computer enhanced imagery developed by color compositing stretched MSS ratio data was constructed for a test site in northwestern Saudi Arabia. Initial results indicate that several igneous and sedimentary rock-types can be discriminated. Author

**N76-17523\*** Rockwell International Science Center, Thousand Oaks, Calif.

**MINERAL TARGET AREAS IN NEVADA FROM GEOLOGICAL ANALYSIS OF LANDSAT-1 IMAGERY**

Monem Abdel-Gawad and Linda Tubbesing / In NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 1059-1078 refs

(G-28) CSCL 08G

Geological analysis of LANDSAT-1 Scene MSS 1053-17540 suggests that certain known mineral districts in east-central Nevada frequently occur near faults or at faults or lineament intersections and areas of complex deformation and flexures. Seventeen (17) areas of analogous characteristics were identified as favorable targets for mineral exploration. During reconnaissance field trips eleven areas were visited. In three areas evidence was found of mining and/or prospecting not known before the field trips. In four areas favorable structural and alteration features were observed which call for more detailed field studies. In one of the four areas limonitic iron oxide samples were found in the regolith of a brecciated dolomite ridge. This area contains quartz veins, granitic and volcanic rocks and lies near the intersection of two linear fault structures identified in the LANDSAT-1 imagery. Semiquantitative spectroscopic analysis of selected portions of the samples showed abnormal contents of arsenic, molybdenum, copper, lead, zinc, and silver. These limonitic samples found were not in situ and further field studies are required to assess their source and significance. Author

**N76-17524\*** National Research Council, Pisa (Italy).

**ATTEMPT AT CORRELATING ITALIAN LONG LINEAMENTS FROM LANDSAT-1 SATELLITE IMAGES WITH SOME GEOLOGICAL PHENOMENA. POSSIBLE USE IN GEOTHERMAL ENERGY RESEARCH**

Enrico Barbier and Mario Fanelli / In NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 1079-1086 refs

(G-29) CSCL 08B

By utilizing the images from the LANDSAT-1, in the spectral band 0.8-1.1 microns (near infrared), a photomosaic was obtained of Italian territory. From this mosaic the field of long lineaments was drawn, corresponding to fractures of the earth crust more than 100 km long. The relationship between lineaments, hot springs, volcanic areas, and earthquake epicenters is verified. There is a clear connection between long lineaments and hot springs: 78% of the springs are located on one or more lineaments, and the existence of hot lineaments was observed. A slightly weaker, but still significant, connection

exists between the Pliocene-Quaternary volcanic areas and long lineaments. The relationship between earthquakes and long lineaments can only be verified in some cases. The lineaments which can be related to earthquakes have little or no connection with the other phenomena. Author

**N76-17536\*** Woodward-Clyde Consultants, Clifton, N.J.  
**GEOLOGIC ANALYSES OF LANDSAT-1 MULTISPECTRAL IMAGERY OF A POSSIBLE POWER PLANT SITE EMPLOYING DIGITAL AND ANALOG IMAGE PROCESSING**

Jon R. Lovegreen, William J. Prosser, and Richard A. Millet In NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 1293-1308 refs

(I-12) CSCL 08F

A site in the Great Valley subsection of the Valley and Ridge physiographic province in eastern Pennsylvania was studied to evaluate the use of digital and analog image processing for geologic investigations. Ground truth at the site was obtained by a field mapping program, a subsurface exploration investigation and a review of available published and unpublished literature. Remote sensing data were analyzed using standard manual techniques. LANDSAT-1 imagery was analyzed using digital image processing employing the multispectral Image 100 system and using analog color processing employing the VP-8 image analyzer. This study deals primarily with linears identified employing image processing and correlation of these linears with known structural features and with linears identified manual interpretation; and the identification of rock outcrops in areas of extensive vegetative cover employing image processing. The results of this study indicate that image processing can be a cost-effective tool for evaluating geologic and linear features for regional studies encompassing large areas such as for power plant siting. Digital image processing can be an effective tool for identifying rock outcrops in areas of heavy vegetative cover. Author

**N76-17617\*** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

**GEOLOGY**

Robert K. Stewart, Floyd F. Sabins, Jr. (Chevron Oil Field Res. Co.), Lawrence C. Rowan (Geological Survey, Reston, Va.), and Nicholas M. Short (NASA. Goddard Space Flight Center, Greenbelt, Md.) In *its.* NASA Earth Resources Surv. Symp., Vol. 3 Jun. 1975 p 21-28

CSCL 08G

Papers from private industry reporting applications of remote sensing to oil and gas exploration were presented. Digitally processed LANDSAT images were successfully employed in several geologic interpretations. A growing interest in digital image processing among the geologic user community was shown. The papers covered a wide geographic range and a wide technical and application range. Topics included: (1) oil and gas exploration, by use of radar and multisensor studies as well as by use of LANDSAT imagery or LANDSAT digital data, (2) mineral exploration, by mapping from LANDSAT and Skylab imagery and by LANDSAT digital processing, (3) geothermal energy studies with Skylab imagery, (4) environmental and engineering geology, by use of radar or LANDSAT and Skylab imagery, (5) regional mapping and interpretation, and digital and spectral methods. Author

**N76-18585\*** Maryland Geological Survey, Baltimore.  
**INVESTIGATION OF THE GEOLOGY, MINERAL RESOURCES AND WATER RESOURCES OF THE STATE OF MARYLAND Final Report**

Kenneth N. Weaver, Principal Investigator Nov. 1975 21 p refs EREP (Contract NAS9-13294) (E76-10164; NASA-CR-144470) Avail: NTIS HC \$3.50 CSCL 08F

**N76-18587\*** California Earth Science Corp., Santa Monica.  
**FAULT TECTONICS AND EARTHQUAKE HAZARDS IN THE**

**PENINSULAR RANGE, SOUTHERN CALIFORNIA**

Paul M. Merifield, Principal Investigator 10 Feb. 1976 5 p refs EREP (Contract NAS2-7698) (E76-10166; NASA-CR-146367; MPR-32) Avail: NTIS HC \$3.50 CSCL 08G

**N76-18602\*** Instituto de Pesquisas Espaciais, Sao Paulo (Brazil).  
**CASE STUDIES ON THE GEOLOGICAL APPLICATION OF LANDSAT IMAGERY IN BRAZIL**

Fernando DeMendonca, Principal Investigator, Aderbal C. Correa, and Chan C. Liu Aug. 1975 37 p refs Sponsored by NASA Submitted for publication Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS (E76-10181; NASA-CR-146380; INPE-729-PE/006) Avail: NTIS HC \$4.00 CSCL 08G

The author has identified the following significant results. Sao Domingos Range, Pocos de Caldas, and Araguaia and Tocantins Rivers in Brazil were selected as test sites for LANDSAT imagery. The satellite images were analyzed using conventional photointerpretation techniques, and the results indicate the application of small scale image data in regional structural data analysis, geological mapping, and mineral exploration.

**N76-18606\*** North Carolina State Univ., Raleigh. Dept. of Geosciences.

**UTILIZATION OF EREP DATA IN GEOLOGICAL EVALUATION, REGIONAL PLANNING, FOREST MANAGEMENT, AND WATER MANAGEMENT IN NORTH CAROLINA Final Report, Mar. 1973 - Oct. 1975**

Charles W. Welby, Principal Investigator and J. O. Lammi Oct. 1975 211 p refs Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 EREP (Contract NAS9-13321) (E76-10185; NASA-CR-144104) Avail: NTIS HC \$7.75 CSCL 08F

The author has identified the following significant results. The S190A, S190B, and S192 photographs and imagery were studied, using standard air-photo interpretation techniques supplemented by color additive viewing and density slicing. The EREP data were found to have potential usefulness for natural resource inventory work, water quality monitoring, and land use mapping for specific problems at scales up to 1:30,000. Distinctions between forest types in North Carolina are limited to conifers, mixed conifer-hardwoods, and hardwoods. Geologic interpretation was limited to detection of lineaments; lithologic differentiation and soil group mapping have proved infeasible in North Carolina except for differentiation of wetland soils in the coastal plain. Imagery from the S192 multispectral scanner has proved to be capable of useful discriminations for vegetation and crop analysis.

**N76-18610\*** Colorado Univ., Boulder. Inst. of Arctic and Alpine Research.

**MULTIPLE RESOURCE EVALUATION OF REGION 2, US FOREST SERVICE LANDS UTILIZING LANDSAT MSS DATA Quarterly Progress Report, 1 Dec. 1975 - 29 Feb. 1976**

Paula V. Krebs and Roger M. Hoffer, Principal Investigators (Purdue Univ.) 29 Feb. 1976 27 p refs Prepared in cooperation with Forest Service, Denver ERTS (Contract NAS5-20948) (E76-10189; NASA-CR-146287) Avail: NTIS HC \$4.00 CSCL 08F

**N76-18618\*** Colorado School of Mines, Golden. Dept. of Geology.

**GEOLOGIC INTERPRETATION OF SKYLAB PHOTOGRAPHS**

Keenan Lee, Principal Investigator and Robert J. Weimer Dec. 1975 85 p refs EREP

## 04 GEOLOGY AND MINERAL RESOURCES

(Contract NAS9-13394)  
(E76-10199; NASA-CR-146290; Rept-75-6) Avail: NTIS  
HC \$5.00 CSCL 08G

**N76-18626\*** National Academy of Sciences - National Research Council, Washington, D.C.

### **EXTRACTABLE RESOURCES Practical Applications of Space Systems**

1975 32 p refs

(Contract NSR-09-012-106)

(NASA-CR-146407; Paper-6) Avail: NTIS HC \$4.00; Space Applications Board, National Research Council, 2101 Constitution Avenue, N. W., Washington, D. C. 20418 CSCL 08G

The use of information from space systems in the operation of extractive industries, particularly in exploration for mineral and fuel resources was reviewed. Conclusions and recommendations reported are based on the fundamental premise that survival of modern industrial society requires a continuing secure flow of resources for energy, construction and manufacturing, and for use as plant foods. Author

**N76-19514\*** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. **COMPARISON OF SKYLAB AND LANDSAT IMAGES FOR GEOLOGIC MAPPING IN NORTHERN ARIZONA** Final Report

A. F. H. Goetz, Principal Investigator, M. J. Abrams, A. R. Gillespie, B. S. Siegal, D. P. Elston (Geological Survey, Flagstaff, Ariz.), J. Lucchitta (Geological Survey, Flagstaff, Ariz.), S. S. C. Wu (Geological Survey, Flagstaff, Ariz.), A. Sanchez (Geological Survey, Flagstaff, Ariz.), W. D. DiPaola (Geological Survey, Flagstaff, Ariz.), F. J. Schafer (Geological Survey, Flagstaff, Ariz.) et al 27 Feb. 1976 201 p refs Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Contract NAS7-100)

(E76-10206; NASA-CR-147503) Avail: NTIS HC \$7.75 CSCL 08G

The author has identified the following significant results. It was found that based on resolution, the Skylab S190A products were superior to LANDSAT images. Based on measurements of shoreline features in Lake Mead S190A images had 1.5 - 3 times greater resolution than LANDSAT. In general, the higher resolution of the Skylab data yielded better discrimination among rock units, but in the case of structural features, lower sun angle LANDSAT images (50 deg) were superior to higher sun angle Skylab images (77 deg). The most valuable advantage of the Skylab over the LANDSAT image products is the capability of producing stereo images. Field spectral reflectance measurements on the Coconino Plateau were made in an effort to determine the best spectral band for discrimination of the six geologic units in question, and these bands were 1.3, 1.2, 1.0, and 0.5 microns. The EREP multispectral scanner yielded data with a low signal to noise ratio which limited its usefulness for image enhancement work. Sites that were studied in Arizona were Shivwits Plateau, Verde Valley, Coconino Plateau, and Red Lake. Thematic maps produced by the three classification algorithms analyzed were not as accurate as the maps produced by photointerpretation of composites of enhanced images.

**N76-20579\*** Ohio Dept. of Economic and Community Development, Columbus.

### **UTILIZING SKYLAB DATA IN ON-GOING RESOURCES MANAGEMENT PROGRAMS IN THE STATE OF OHIO** Final Report, Apr. - Aug. 1975

P. E. Baldridge, Principal Investigator, P. H. Goesling, T. A. Martin, G. E. Wukelic (Battelle Columbus Labs., Ohio), J. G. Stephan (Battelle Columbus Labs., Ohio), H. E. Smail (Battelle Columbus Labs., Ohio), and T. F. Ebbert (Battelle Columbus Labs., Ohio) Nov. 1975 139 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 EREP

(Contract NAS3-19521)

(E76-10229; NASA-CR-134938) Avail: NTIS HC \$6.00 CSCL 05B

The author has identified the following significant results. The use of Skylab imagery for total area woodland surveys was found to be more accurate and cheaper than conventional surveys using aerial photo-plot techniques. Machine-aided (primarily density slicing) analyses of Skylab 190A and 190B color and infrared color photography demonstrated the feasibility of using such data for differentiating major timber classes including pines, hardwoods, mixed, cut, and brushland providing such analyses are made at scales of 1:24,000 and larger. Manual and machine-assisted image analysis indicated that spectral and spatial capabilities of Skylab EREP photography are adequate to distinguish most parameters of current, coal surface mining concern associated with: (1) active mining, (2) orphan lands, (3) reclaimed lands, and (4) active reclamation. Excellent results were achieved when comparing Skylab and aerial photographic interpretations of detailed surface mining features. Skylab photographs when combined with other data bases (e.g., census, agricultural land productivity, and transportation networks), provide a comprehensive, meaningful, and integrated view of major elements involved in the urbanization/encroachment process.

**N76-20583\*** Earth Satellite Corp., Washington, D.C.

### **APPLICATION OF LANDSAT-2 DATA TO THE IMPLEMENTATION AND ENFORCEMENT OF THE PENNSYLVANIA SURFACE MINING CONSERVATION AND RECLAMATION ACT** Progress Report, 19 Dec. 1975 - 19 Mar. 1976

Daniel J. Deely, Principal Investigator 19 Mar. 1976 8 p ERTS

(Contract NAS5-21998)

(E76-10233; NASA-CR-146516; C-1037-2-4;

Rept-21570-2-4) Avail: NTIS HC \$3.50 CSCL 08I

**N76-20588\*** Utah Univ., Salt Lake City. Coll. of Mines.

### **REMOTE SENSING IN MINERAL EXPLORATION FROM LANDSAT IMAGERY** Quarterly Report, Oct. - Dec. 1975

M. P. Nackowski, Principal Investigator 11 Feb. 1976 8 p ERTS

(Contract NAS5-20955)

(E76-10240; NASA-CR-146523) Avail: NTIS HC \$3.50 CSCL 08G

The author has identified the following significant results. Preliminary statistical analysis of length and azimuth of linear stream segments in the Battle Mountain area suggest that segment length (discriminating criterion) can be used to distinguish mineralized from nonmineralized areas.

**N76-20589\*** Utah Univ., Salt Lake City. Coll. of Mines.

### **REMOTE SENSING IN MINERAL EXPLORATION FROM LANDSAT IMAGERY** Quarterly Report, Jun. - Sep. 1975

M. P. Nackowski, Principal Investigator 3 Nov. 1975 4 p ERTS

(Contract NAS5-20955)

(E76-10241; NASA-CR-146524) Avail: NTIS HC \$3.50 CSCL 14E

**N76-20592\*** Eason Oil Co., Oklahoma City, Okla.

### **EVALUATION OF THE SUITABILITY OF SKYLAB DATA FOR THE PURPOSE OF PETROLEUM EXPLORATION** Final Report

Robert J. Collins, Principal Investigator, Gerald J. Petzel, and John R. Everett (Earth Satellite Corp., Washington, D. C.) Dec. 1975 158 p refs Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 EREP

(Contract NAS9-13297)

(E76-10244; NASA-CR-147468) Avail: NTIS HC \$6.75 CSCL 08G

**N76-20593\*** Geological Survey, Washington, D.C.

### **PREPARATION OF A GEOLOGIC PHOTO MAP AND HYDROLOGIC STUDY OF THE YEMEN ARAB REPUBLIC** Quarterly Report, Dec. 1975

D. F. Davidson, Principal Investigator Dec. 1975 3 p ERTS  
(E76-10246; NASA-CR-146528) Avail: NTIS HC \$3.50 CSCL  
08F

**N76-20594\*#** Missouri Univ., Rolla.  
**STRUCTURAL AND GROUND PATTERN ANALYSIS OF  
MISSOURI AND THE OZARK DOME USING LANDSAT-2  
SATELLITE IMAGERY** Quarterly Progress Report, Jul. - Sep.  
1975

Geza Kisvarsanyi and Eva B. Kisvarsanyi, Principal Investigators  
Sep. 1975 11 p refs ERTS  
(Contract NAS5-20937)  
(E76-10247; NASA-CR-146529; QPR-2) Avail: NTIS  
HC \$3.50 CSCL 08E

**N76-20597\*#** Geological Survey, Reston, Va.  
**EVALUATION OF LANDSAT-2 (ERTS) IMAGES APPLIED  
TO GEOLOGIC STRUCTURES AND MINERAL RESOURCES  
OF SOUTH AMERICA** Progress Report, 14 Mar. - 30 Jun.  
1975

William D. Carter, Principal Investigator 1 Jul. 1975 44 p  
refs Sponsored by NASA ERTS  
(E76-10250; NASA-CR-146624) Avail: NTIS HC \$3.50 CSCL  
08G

The author has identified the following significant results. Work with the Image 100 clearly demonstrates that radiance values of LANDSAT data can be used for correlation of geologic formations across international boundaries. The Totora Formation of the Corocoro Group of Tertiary age was traced from known outcrops near Tiahuanaco, Bolivia, along the south side of Lake Titicaca westward into Peru where the same rocks are considered to be Cretaceous in age. This inconsistency suggests: (1) that a review of this formation is needed by joint geological surveys of both countries to determine similarities, differences, and the true age; (2) that recognition of the extension of the copper-bearing Totora Formation of Bolivia into Peru may provide Peru with a new target for exploration. Equal radiance maps made by use of the Image 100 system show as many as eight different units within salt deposits (salt flats) of the Bolivian Altiplano. Standard film processed images show them as nearly uniform areas of white because of lack of dynamic range in film products. The Image 100 system, therefore, appears to be of great assistance in subdividing the salt flats on the basis of moisture distribution; surface roughness, and distribution of windblown materials. Field work is needed to determine these relationships to mineral composition and distribution. Images representing seasonal changes should also improve the accuracy of such maps. Radiance values of alteration zones related to the occurrence of porphyry copper ores were measured at the San Juan del Abra deposit of northern Chile using the Image 100 system. The extent to which these same values may be used to detect similar alteration zones in other areas has not yet been tested.

**N76-20598\*#** Geological Survey, Denver, Colo. Branch of  
Petrophysics and Remote Sensing.

**A PHOTOGEOLOGIC COMPARISON OF SKYLAB AND  
LANDSAT IMAGES OF SOUTHWESTERN NEVADA AND  
SOUTHEASTERN CALIFORNIA** Final Report

D. W. O'Leary and H. A. Pohn, Principal Investigators [1975]  
79 p refs Original contains imagery. Original photography  
may be purchased from the EROS Data Center, 10th and Dakota  
Avenue, Sioux Falls, S. D. 57198 EREP  
(NASA Order T-6555-B)  
(E76-10251; NASA-CR-144642) Avail: NTIS HC \$5.00 CSCL  
08B

**N76-20620#** Geological Survey, Reston, Va.  
**DEVELOPMENT AND APPLICATION OF REMOTE-SENSING  
TECHNIQUES IN THE SEARCH FOR DEPOSITS OF COPPER  
AND OTHER METALS IN HEAVILY VEGETATED AREAS.  
STATUS REPORT 1 JUNE 1975** Project Report for Jan. -  
Jun. 1975

Frank C. Canney 1975 45 p  
(Grant PASA-TA(IC)-05-73)  
(PB-246284/4; USGS-GD-75-020; IR-NC-48) Avail: NTIS  
HC \$4.00 CSCL 08G

Experiments in the use of visual photointerpretation of  
multiband photography to detect changes in vegetation caused  
by abnormal concentrations of metals in soil are described.  
Cooperative efforts are being made to study areas in Brazil,  
Philippines, and Thailand. GRA

**N76-21643\*#** Department of Industry, London (England).  
**THE USE OF ERTS/LANDSAT IMAGERY IN RELATION TO  
AIRBORNE REMOTE SENSING FOR TERRAIN ANALYSIS  
IN WESTERN QUEENSLAND, AUSTRALIA** Quarterly  
Report

Monica M. Cole, Principal Investigator and Stewart Owen-Jones  
26 Mar. 1976 23 p Sponsored by NASA and United Kingdom  
Dept. of Industry Original contains imagery. Original photography  
may be purchased from the EROS Data Center, 10th and Dakota  
Avenue, Sioux Falls, S. D. 57198 ERTS  
(E76-10276; NASA-CR-146542) Avail: NTIS HC \$3.50 CSCL  
08B

The author has identified the following significant results. LANDSAT 1 and 2 imagery contrast the geology of the Cloncurry-Dobbyn and the Gregory River-Mt. Isa areas very clearly. Known major structural features and lithological units are clearly displayed while, hitherto unknown lineaments were revealed. Throughout this area, similar rock types produce similar spectral signatures, e.g. quartzites produce light signatures, iron rich rocks produce dark signatures. More geological data are discernible at the 1:50,000 scale than on the 1:250,000 scale. Ore horizons may be identified at the 1:50,000 scale, particularly where they are associated with iron rich rocks. On the level plains north of Cloncurry, distinctive spectral signatures produced by the combined reflectances of plant cover, soils, and geology, distinguish different types of superficial deposits. Existing and former channels of the Cloncurry and Williams Rivers are distinguished at the 1:50,000 scale on both the LANDSAT 1 and 2 imagery. On the Cloncurry Plains, fence lines are discernible on the 1:50,000 LANDSAT 2 imagery.

**N76-21650\*#** Geological Survey, Reston, Va.  
**DETECTION AND MAPPING OF MINERALIZED AREAS IN  
THE CORTEZ-UINTA BELT, UTAH-NEVADA, USING  
COMPUTER-ENHANCED ERTS IMAGERY** Progress Report  
Lawrence C. Rowan, Principal Investigator 15 Feb. 1976 40 p  
refs Sponsored by NASA Original contains color imagery. Original  
photography may be purchased from the EROS Data Center,  
10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS  
(E76-10283; NASA-CR-146653) Avail: NTIS HC \$4.00 CSCL  
08G

The author has identified the following significant results. Mineralogical differences between hydrothermally altered rocks and most unaltered rocks in south central Nevada cause visible and near infrared (0.45-2.4 micron) spectral reflectance differences which can be used to discriminate broad categories of rocks in multispectral images. The most important mineralogical differences are the increased abundance of goethite, hematite, jarosite, alunite, montmorillonite, and kaolinite in the altered zones. Because of the wavelength positions and widths of the LANDSAT MSS bands, these spectral differences are not apparent in individual or color infrared composite MSS images. The technique developed to enhance these subtle spectral differences combines ratioing of the MSS bands and contrast stretching. Field evaluation of color-ratio composite shows that, after exclusion of alluvial areas, approximately 80% of the green and brown color patterns are related to hydrothermal alteration. The remaining 20% consists mainly of pink hematitic crystallized tuff and tan or red ferruginous shale and siltstone.

**N76-21654\*#** Iowa Univ., Iowa City. Dept. of Geology.  
**EXPERIMENT TO EVALUATE THE FEASIBILITY OF  
UTILIZING SKYLAB-EREP REMOTE SENSING DATA FOR  
TECTONIC ANALYSIS THROUGH A STUDY OF THE BIG**

## 04 GEOLOGY AND MINERAL RESOURCES

### **HORN MOUNTAIN REGION, WYOMING, SOUTH DAKOTA AND WYOMING Final Report, Apr. 1973 - Sep. 1975**

Richard A. Hoppin, Principal Investigator, James Caldwell, Donald Lehman, Steven Palmer, Kuo-Liang Pan, and Alan Swenson Mar. 1976 57 p refs Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 EREP

**N76-21662\*#** Colorado School of Mines, Golden. Dept. of Geology.

### **REMOTE SENSING IN MINERAL EXPLORATION FROM LANDSAT (ERTS) IMAGERY. TEST SITE NO. 2 (COLORADO) Progress Report, 31 Dec. 1975 - 31 Mar. 1976**

R. H. Carpenter, Principal Investigator and D. W. Trexler Apr. 1976 7 p ref ERTS (Contract NAS5-20955) (E76-10295; NASA-CR-146785) Avail: NTIS HC \$3.50 CSCL 08G

**N76-21670#** Illinois Univ., Champaign. Center for Advanced Computation.

### **RESERVE AND RESOURCE ESTIMATION. APPENDIX D Final Report**

Michael Rieber, Shao Lee Soo, and James Stukel May 1975 72 p refs

(Grant NSF GI-35821) (PB-248063/O; CAC-163-App-D; NSF/RA/N-75-037D) Avail: NTIS HC \$4.50 CSCL 08G

Briefly discussed are Illinois and Wyoming coal reserves, availability of public land for coal mining, National Environmental Policy Act, Clean Air Act, and Federal Water Pollution Control Act. GRA

### **N76-21674#** Air Samplex Corp., Indian Hills, Colo. **GEOLOGY, ORE DEPOSITS, AND MINERAL POTENTIAL OF THE SEWARD PENINSULA ALASKA Open File Report, 1965 - 1975**

C. L. Sainsbury Sep. 1975 134 p refs (PB-247099/5; BM-OFR-73-75) Avail: NTIS HC \$6.00 CSCL 08G

Efforts made to put under one title all of the geologic maps of the Seward Peninsula, Alaska, published in open files since 1965 are reported. Attempts were also made to synthesize the economic geology and mineral potential of that important region as an aid to those presently concerned with land selections and evaluations, and to speculate on areas where undiscovered mineral resources may exist. GRA

### **N76-21675\*#** California Earth Science Corp., Santa Monica. **APPLICATION OF SKYLAB AND ERTS IMAGERY TO FAULT TECTONICS AND EARTHQUAKE HAZARDS OF PENINSULAR RANGES, CALIFORNIA; SOUTHWESTERN Final Report**

D. L. Lamar and P. M. Merifield Jul. 1975 73 p refs Sponsored by NASA and Geol. Surv., Menlo Park, Calif. (Contracts DI-14-08-001-13911; NAS2-7698) (NASA-CR-146985; PB-247896/4; TR-75-2; USGS-LI-75-010) Avail: NTIS HC \$4.50 CSCL 08G

Prominent linears in basement terrane of the Peninsular Ranges, southwestern California, appear on Skylab and ERTS images. Those most prominent are formed by active fault zones. Those not well defined have less horizontal displacements suggesting distinctness on the imagery may be related to amount of horizontal slip. Field investigations aided by study of large scale aerial photos were accomplished to determine the geologic characteristics of other linears and the earthquake generating potential of previously unmapped faults. The available data about newly uncovered faults is that they are inactive and therefore are not likely to generate earthquakes. GRA

### **N76-21720#** Mitre Corp., McLean, Va. **ENERGY RESOURCES FOR THE YEAR 2000 AND BEYOND, WITH SCENARIOS FOR THE YEAR 2000 AND THE YEAR 2100**

Charles A. Zraket Mar. 1975 55 p refs Presented at Conf. on Towards a Plan of Action for Mankind, Needs, and Resources, Paris, 9-13 Sep. 1974 (PB-247413/8; MTP-401-Rev-2) Avail: NTIS HC \$4.50 CSCL 10A

The following topics are discussed: current and projected World use of energy resources; energy sources and environmental effects; two scenarios for the year 2000 and the year 2100; new techniques for energy generation and transmission; the transportation sector. GRA

**N76-21804#** Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.

### **MID-INFRARED SPECTRAL BEHAVIOR OF SEDIMENTARY ROCKS Environmental Research Papers**

Graham R. Hunt and John W. Salisbury 2 Jul. 1975 49 p (AF Proj. 7670)

(AD-A016427; AFCRL-TR-75-0356; AFCRL-ERP-520) Avail: NTIS CSCL 08/7

Mid-infrared (6- to 40-micrometer) spectra of sedimentary rocks and rock-forming minerals are presented. Molecular vibration bands are identified and the causes of spectral scatter among different samples of the same rock type are determined. It is concluded that mid-infrared spectra of sedimentary rocks are an excellent guide to their major mineral content. The chief drawback for terrestrial remote sensing of these rocks is that the major carbonate absorption band lies outside the atmospheric window. Author (GRA)

**N76-21813#** Army Cold Regions Research and Engineering Lab., Hanover, N.H.

### **RADIOWAVE RESISTIVITY MEASUREMENTS IN NORTHERN MAINE FOR IDENTIFYING BEDROCK TYPE**

Paul V. Sellman, Allan J. Delaney, and Pieter Hoekstra Oct. 1975 18 p refs

(AD-A017944; CRREL-SR-238) Avail: NTIS CSCL 08/7

A preliminary ground resistivity survey using the VLF radiowave method was conducted in northern Maine near the site of the proposed Dickey-Lincoln dam and hydroelectric project. This survey was intended to establish if adequate resistivity contrasts exist between bedrock types in the area to warrant further bedrock distribution studies by airborne resistivity techniques. A more complete understanding of the geology of this area was considered necessary in an attempt to locate rock types suitable for construction purposes near the proposed construction sites. Field observations were made on all types commonly found in the area, including the dominant gray slates and the less common orthoquartzites and granodiorites. The granodiorites are considered most suitable for construction purposes. GRA

**N76-21814#** Army Engineer Topographic Labs., Fort Belvoir, Va.

### **SURFACE MATERIALS AND TERRAIN FEATURES OF YUMA PROVING GROUND. PART 1: SUMMARY DESCRIPTION**

H. Frank Barnett, Jr. May 1975 18 p refs (DA Proj. 1T1-62112-A-528)

(AD-A018175; ETL-0021) Avail: NTIS CSCL 08/7

This report summarizes geologic and terrain information pertinent to the conduct of materiel testing at the U.S. Army Yuma Proving Ground. Surface features are described in two categories -- Bedrock Mountains and Alluvial Lowlands. Only the Alluvial Lowlands are extensively and continuously used in testing; they, therefore, are treated in greater detail as differing in grain sizes of materials and relative degrees of surface dissection. The distribution of surficial materials, based on mapping at a scale of 1:62,500, is generalized at a scale of 1:500,000 for this summary. The mapping program and related activities provide a basis for improvement of field environmental testing, particularly

in relation to ground-vehicle mobility, surface transportability, and vulnerability to detection. GRA

**N76-21831#** Bureau of Mines, Denver, Colo. Mining Research Center.

**DETECTION AND DELINEATION OF FAULTS BY SURFACE RESISTIVITY MEASUREMENTS. CONDA MINE, CARIBOU COUNTY, IDAHO**

Robert Lee Stahl 1975 25 p refs  
(PB-247222/3; BM-RI-8072) Avail: NTIS HC \$3.50 CSCL 08G

Comprehensive field tests were made by the Bureau of Mines at the Conda open pit mine near Soda Springs, Idaho, to determine whether surface geophysical techniques could be used to detect and delineate faults in phosphate deposits. The tests included seismic refraction, magnetometer, electrical resistivity, and airborne photography. Of the several geophysical techniques tested in the field, horizontal resistivity profiling was most diagnostic of faults. The method is quick, inexpensive, and accurate and can be easily used by mining company personnel to detect and delineate faults. GRA



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## OCEANOGRAPHY AND MARINE RESOURCES

Includes sea-surface temperature, ocean bottom surveying imagery, drift rates, sea ice and icebergs, sea state, fish location.

**A76-20334 \*** Ocean color spectra measured off the Oregon coast - Characteristic vectors. J. L. Mueller (NASA, Goddard Space Flight Center, Hydrology and Oceanography Branch, Greenbelt, Md.). *Applied Optics*, vol. 15, Feb. 1976, p. 394-402. 20 refs. Contract No. N62306-70-C-0414.

The ocean color spectrum is defined as the ratio of the spectrum of light upwelled from the sea to the spectrum of light incident on the sea surface. Ocean color spectra, observed from an airplane flown over waters off Oregon, are analyzed. The original spectra are resolved into fifty-five wavelength bands, each 5 nm wide. The shapes of these spectra are parameterized by, and shown to be accurately recoverable from, their first four principal components. These components are the scalar projections of each spectrum on the first four characteristic vectors of the sample covariance matrix. Regression equations are found with which phytoplankton pigment concentration and water transparency may be estimated as linear functions of the principal components. Pigment concentration estimates thus obtained are imprecise. The poor fit is at least partly due to the inappropriateness of the linear regression model and the neglect of other optically important substances typically present in sea water. (Author)

**A76-21797** Remote sensing of the dynamics of sea ice and water temperatures with the aid of satellites (Fernerkundung von Meereisdynamik und Wassertemperaturen mit Satelliten). H. Kaminski (Bochum, Sternwarte, Bochum, West Germany). *Naturwissenschaften*, vol. 62, 1975, p. 211-213. 20 refs. In German.

Studies of the area distribution of sea water temperatures and the dynamics of sea ice are important in connection with investigations of the global energy balance and the determination of climatic fluctuations. Such studies can also contribute to the safety of navigation and the efficiency of fishing operations. The conduction of such studies is discussed, taking into account the results of the study and the employed technique. G.R.

**A76-22664 \*** Beaufort Sea ice zones as delineated by microwave imagery. W. J. Campbell (U.S. Geological Survey, Tacoma, Wash.), P. Gloersen, W. J. Webster, T. T. Wilheit (NASA, Goddard Space Flight Center, Greenbelt, Md.), and R. O. Ramseier (Department of the Environment, Ottawa, Canada). *Journal of Geophysical Research*, vol. 81, Feb. 20, 1976, p. 1103-1110. 7 refs.

Microwave and infrared data were obtained from a research aircraft over the Beaufort Sea ice from the shoreline of Harrison Bay northward to a latitude of almost 81 deg N. The data acquired were compared with microwave data obtained on the surface at an approximate position of 75 deg N, 150 deg W. Over this north-south transect of the polar ice canopy it was discovered that the sea ice could be divided into five distinct zones. The shorefast sea ice was found to consist uniformly of first-year sea ice. The second zone was found to be a mixture of first-year sea ice, medium size multiyear floes, and many recently refrozen leads, polynyas, and open water; considerable shearing activity was evident in this zone. The third zone was a mixture of first-year and multiyear sea ice which had a uniform microwave signature. The fourth zone was found to be a mixture of first-year sea ice and medium-to-large size multiyear floes which was similar in composition to the second zone. The fifth zone was almost exclusively multiyear ice extending to the North Pole. (Author)

**A76-23432 #** Stationary antarctic polynyas from satellite data (Statsionarnye polyn'i antarktiki po sputnikovym dannym). V. V. Evseev (Arkticheskii i Antarkticheskii Nauchno-Issledovatel'skii Institut, Leningrad, USSR). *Sovetskaya Antarkticheskaya Ekspeditsiya, Informatsionnyi Biulleten'*, no. 91, 1975, p. 20-27. 7 refs. In Russian.

Satellite photographs taken in 1970-1971 have been used to investigate the distribution and development of polynyas over the greater portion of the antarctic icebelt. The system of stationary polynyas around the antarctic continent is a characteristic feature of the ice regime. In the region between 50 and 170 deg longitude the extent of the polynyas sharply increases in September, reaching a maximum in November and December. In the region between 0 and 50 deg longitude the extent of polynyas is somewhat greater than the more eastern region due to the less rough coastline. In areas of heavier ice conditions, such as the western portion of the Weddell Sea, polynyas either are totally absent or occur only at the end of the summer. C.K.D.

**A76-23748** Measurement of sea surface temperature by the NOAA 2 satellite. J. L. Cogan and J. H. Willand (Environmental Research and Technology, Inc., Concord, Mass.). *Journal of Applied Meteorology*, vol. 15, Feb. 1976, p. 173-180. 20 refs. Contract No. N66314-73-C-1749.

**A76-24536 #** Survey of investigations of oceanographic fields by remote sounding from spacecraft (Obzor issledovaniia okeanograficheskikh polei metodom distantsionnogo zondirovaniia s kosmicheskikh letatel'nykh apparatov). V. V. Polovinko. *Geodeziia i Aerofotos'emka*, no. 3, 1975, p. 171-177. 9 refs. In Russian.

**A76-27270 \*** An analysis of Skylab II S193 scatterometer data. A. K. Jordan, C. G. Purves, and J. F. Diggs (U.S. Navy, Naval Research Laboratory, Washington, D.C.). *IEEE Transactions on Geoscience Electronics*, vol. GE-14, Apr. 1976, p. 97-100. 22 refs. NASA Order L-7913-A.

Skylab II S193 scatterometer data for the passes of June 5, 1973, over the Gulf of Mexico and June 6, 1973, over Pacific Hurricane AVA were analyzed. These two passes were chosen since it was possible to correlate the scattering data with simultaneous measurements of the local ocean wind conditions. The S193 scatterometer measured the radar cross section of the ocean at 13.9 GHz (Ku-band) as a function of incidence angle. The S193 data of June 5, 1973, when a practically uniform wind field was present, show reasonable agreement with the Naval Research Laboratory (NRL) empirical and theoretical models. The data of June 6, 1973, are more complex, due to rapid variations in wind speeds and directions around Hurricane AVA. The NRL empirical model was interpolated to account for variation in wind heading relative to the S193 antenna pointing direction; a reasonable comparison could then be made with the corresponding S193 data of June 6, 1973. (Author)

**N76-16527\*#** Delaware Univ., Newark. Coll. of Marine Studies.

### APPLICATION OF LANDSAT TO IDENTIFY POTENTIAL ON-SHORE IMPACT OF OUTER CONTINENTAL SHELF DEVELOPMENT

V. Klemas, Principal Investigator, J. Goodman, H. Lins, and D. Bartlett 8 Jan. 1976 2 p ERTS (Contract NAS5-2983) (E76-10104; NASA-CR-146037) Avail: NTIS HC \$3.50 CSCL 08J

**N76-16539\*#** Delaware Univ., Newark. Coll. of Marine Studies.

### STUDIES OF CURRENT CIRCULATION AT OCEAN WASTE DISPOSAL SITES

## 05 OCEANOGRAPHY AND MARINE RESOURCES

V. Klemas, Principal Investigator, G. Davis, and R. Henry 12 Jan. 1976 2 p ERTS  
(Contract NAS5-20983)  
(E76-10116; NASA-CR-146049) Avail: NTIS HC \$3.50 CSCL 08C

The author has identified the following significant results. Acid waste plume was observed in LANDSAT imagery fourteen times ranging from during dump up to 54 hours after dump. Circulation processes at the waste disposal site are highly storm-dominated, with the majority of the water transport occurring during strong northeasterlies. There is a mean flow to the south along shore. This appears to be due to the fact that northeasterly winds produce stronger currents than those driven by southeasterly winds and by the thermohaline circulation. During the warm months (May through October), the ocean at the dump site stratifies with a distinct thermocline observed during all summer cruising at depths ranging from 10 to 21 m. During stratified conditions, the near-bottom currents were small. Surface currents responded to wind conditions resulting in rapid movement of surface drogues on windy days. Mid-depth drogues showed an intermediate behavior, moving more rapidly as wind velocities increased.

**N76-16605#** Alaska Univ., College. Geophysical Inst.  
**MAJOR LATE-WINTER FEATURES OF ICE IN NORTHERN BERING AND CHUKCHI SEAS AS DETERMINED FROM SATELLITE IMAGERY**

Lewis H. Shapiro and John J. Burns Jun. 1975 22 p Presented at the Ann. Am. Geophys. Union Fall Meeting, San Francisco, 12-17 Dec. 1974 Prepared in cooperation with Alaska Dept. of Fish and Game  
(Grant NOAA-02-3-158-41)  
(COM-75-11343/1; UAG-R-236; Alaska-Sea-Grant-Pub-75-8; NOAA-75090412) Avail: NTIS HC \$3.50 CSCL 08J

Imagery from the ERTS-1, DAPP, and NOAA 2/3 VHRR satellite systems were used for identification of recurring features of the movement and distribution of sea ice in the Bering and Chukchi seas during late winter. The pattern observed is consistent with a general southward drift of sea ice under the influence of the prevailing northerly winds present in the area during this time of year. GRA

**N76-16727#** Research Triangle Inst., Research Triangle Park, N.C.

**QUASI REALTIME OCEANOGRAPHIC EXPERIMENT USING NOAA SATELLITE DATA AND SHIP DATA Final Report**  
Fred M. Vukovich Feb. 1975 65 p refs  
(Grant NOAA-3-35402)  
(COM-75-11356/3; NOAA-75082803) Avail: NTIS HC \$4.50 CSCL 08C

A series of oceanographic studies was performed off the southeast coast of the United States, combining data from the NOAA-2 and NOAA-3 satellite and from the Cape Fear Technical Institute, R/V DALLAS HERRING and R/V ADVANCE II. The phenomena studied consisted of short-period intrusions of shelf water into the Gulf Stream and a cold eddy on the east side of the Gulf Stream. The satellite data were used to identify and locate these perturbations in realtime, and to define the sea surface temperature distribution associated with the perturbations. The results demonstrated that the NOAA satellite data may be used (1) to locate significant oceanic perturbations and (2) to aid in the study of the structure of perturbations by integrating in situ data with the satellite infrared data. GRA

**N76-16728#** TRW Systems Group, Redondo Beach, Calif.

**OCEAN FLIGHT TEST Final Report**

O. W. Momary 9 Jun. 1975 53 p refs  
(Contract NOAA-3-35425)  
(COM-75-11346/4; NOAA-75090202) Avail: NTIS HC \$4.50 CSCL 08A

Aircraft overflights were made over coastal waters off Southern California in early 1975 and the results of that research are presented. As an indication of 'apparent' productivity of the water, a comparison was made of the ratio of reflected energy at selected wavelengths to that obtained from a standard source

of reflectance. The flight test results indicate that such a comparison yields an increase in the ratio with increasing distance from land. This trend implies increasing absorption of solar energy near 6800 Å as one approaches the land mass. Overall results, however, indicate that a measurable quantitative change in backscattered solar energy at discrete wavelength within the region of interest does not appear technically feasible, probably due to the very high absorption of water at the longer wavelengths. GRA

**N76-17455\*#** Tokai Univ., Shizuoka (Japan).

**STUDY OF SEA ICE IN THE SEA OF OKHOTSK AND ITS INFLUENCE ON THE OYASHIO CURRENT Final Report**  
Kantaro Watanabe, Ryuya Kuroda (Tohoku Regional Fisheries Res. Lab.), Katsumi Hata (Japan Meteorological Agency), and Masaomi Akagawa, Principal Investigators (Hakodate Marine Observatory) 26 Dec. 1975 29 p refs Sponsored by NASA and Sci. and Technol. Agency, Japan Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS  
(E76-10146; NASA-CR-144472) Avail: NTIS HC \$4.00 CSCL 08L

The author has identified the following significant results. Two photographic techniques were applied to Skylab S190A multispectral pictures for extracting oceanic patterns at the sea surface separately from cloud patterns. One is the image-masking technique and another a stereographic analysis. The extracted oceanic patterns were interpreted as areas where the amount, or the concentration of phytoplankton was high by utilizing surface data of water temperature, ocean current by GEK, and microplankton.

**N76-17458\*#** Delaware Univ., Newark. Coll. of Marine Studies.

**APPLICATION OF LANDSAT-2 TO THE MANAGEMENT OF DELAWARE'S MARINE AND WETLAND RESOURCES Progress Report. Nov. 1975 - Jan. 1976**

V. Klemas, Principal Investigator, D. Bartlett, W. Philpot, and G. Davis 9 Feb. 1976 8 p refs ERTS  
(Contract NAS5-20983)  
(E76-10149; NASA-CR-146158) Avail: NTIS HC \$3.50 CSCL 08A

The author has identified the following significant results. The spectral signature of the acid waste disposal plume investigated 38 miles off the Delaware coast, is caused primarily by scattering from particles in the form of suspended ferric iron floc. In comparison, the absorption caused by the dissolved fraction of iron and other substances has a negligible effect on the spectral signature. Ocean waste disposal plumes were observed by LANDSAT-1 and -2 during dump up to 54 hours after dump during fourteen different passes over the Delaware test site. The spatial resolution, radiometric sensitivity, and spectral band location of the LANDSAT multispectral scanner are sufficient to identify the location of ocean disposal plumes. The movement and dispersion of ocean waste disposal plumes can be estimated if the original dump location, time, and injection method are known. Operating LANDSAT in the high gain mode helps to determine plume dispersion more accurately.

**N76-17577\*#** Science Applications, Inc., La Jolla, Calif.

**A PROCEDURE FOR ESTIMATION OF SEA-SURFACE TEMPERATURE FROM REMOTE MEASUREMENTS IN THE 10 - 13 MICROMETERS SPECTRAL REGION**

David C. Anding In NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975 p 1953-1972 refs  
(M-4) CSCL 04B

The feasibility is demonstrated of a procedure for the remote measurement of sea-surface temperature which inherently corrects for the effect of the intervening atmosphere without recourse to climatological data. The procedure relies upon the near-linear differential absorption properties of the infrared window region between 10 and 13 micrometers and requires radiometric

measurements in a minimum of two spectral intervals within the infrared window which have a significant difference in absorption coefficient. The procedure was applied to Nimbus 4 infrared interferometer spectrometer (IRIS) data and to Skylab EREP S191 spectrometer data, and it is demonstrated that atmospheric effects on the observed brightness temperature can be reduced to less than 1.0 Kelvin. Author

**N76-17578\*** National Environmental Satellite Service, Suitland, Md.

**SURFACE CIRCULATION IN THE GREAT LAKES AS OBSERVED BY LANDSAT-1 AUGUST 1972 - DECEMBER 1973: SOUTHERN LAKE MICHIGAN**

Harry G. Stumpf and Alan E. Strong /in NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975 p 1973-1988 refs

(M-5) CSCL 04B

The surface current circulation patterns of southern Lake Michigan were charted for all cardinal and subcardinal wind directions, employing LANDSAT-1 observations of the distribution of natural tracing material borne in the surface waters. These colorants consist chiefly of river discharges composed of suspended sediments, pollutants, and algae; extensive chemical precipitations proved valuable for areas farther from shore. Comparison of the satellite-derived surface current charts with previous theoretical and empirical studies shows good agreement. Author

**N76-17579\*** National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

**OCEAN COLOR IMAGERY: COASTAL ZONE COLOR SCANNER**

Warren A. Hovis /in its NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975 p 1989-2003

(M-6) CSCL 14E

Investigations into the feasibility of sensing ocean color from high altitude for determination of chlorophyll and sediment distributions were carried out using sensors on NASA aircraft, coordinated with surface measurements carried out by oceanographic vessels. Spectrometer measurements in 1971 and 1972 led to development of an imaging sensor now flying on a NASA U-2 and the Coastal Zone Color Scanner to fly on Nimbus G in 1978. Results of the U-2 effort show the imaging sensor to be of great value in sensing pollutants in the ocean. Author

**N76-17580\*** Delaware Univ., Newark. Coll. of Marine Studies.

**SKYLAB INVESTIGATION OF THE UPWELLING OFF THE NORTHWEST COAST OF AFRICA**

Karl-Heinz Szekielda, Dennis J. Suszkowski, and Paul S. Tabor /in NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975 p 2005-2021 refs

(M-7) CSCL 08C

The upwelling off the NW coast of Africa in the vicinity of Cape Blanc was studied in February - March 1974 from aircraft and in September 1973 from Skylab. The aircraft study was designed to determine the effectiveness of a differential radiometer in quantifying surface chlorophyll concentrations. Photographic images of the S190A Multispectral Camera and the S190B Earth Terrain Camera from Skylab were used to study distributional patterns of suspended material and to locate ocean color boundaries. The thermal channel of the S192 Multispectral Scanner was used to map sea-surface temperature distributions offshore of Cape Blanc. Correlating ocean color changes with temperature gradients is an effective method of qualitatively estimating biological productivity in the upwelling region off Africa. Author

**N76-17583\*** Environmental Research Inst. of Michigan, Ann Arbor.

**NEARSHORE COASTAL MAPPING**

Fabian C. Polcyn and David R. Lyzenga /in NASA. Lyndon B.

Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975 p 2075-2086 refs

(M-10) CSCL 08B

Two test sites of different water quality and bottom topography were used to test for maximum water depth penetration using the Skylab S-192 MSS for measurement of nearshore coastal bathymetry. Sites under investigation lie along the Lake Michigan coastline where littoral transport acts to erode sand bluffs and endangers developments along 1,200 miles of shore, and on the west coast of Puerto Rico where unreliable shoal location and depth information constitutes a safety hazard to navigation. The S-192 and S-190A and B provide data on underwater features because of water transparency in the blue/green portion of the spectrum. Depth of 20 meters were measured with the S-192 in the Puerto Rico test site. The S-190B photography with its improved spatial resolution clearly delineates the triple sand bar topography in the Lake Michigan test site. Several processing techniques were employed to test for maximum depth measurement with least error. The results are useful for helping to determine an optimum spectral bandwidth for future space sensors that will increase depth measurements for different water attenuation conditions where a bottom reflection is detectable.

**N76-17615\*** National Aeronautics and Space Administration, Earth Resources Labs., Bay St. Louis, Miss.

**COASTAL ZONE MANAGEMENT**

E. Lee Tilton, III /in its NASA Earth Resources Surv. Symp., Vol. 3 Jun. 1975 p 5-14 refs

CSCL 08C

A panel of federal and state representatives concerned with coastal zone affairs discussed their problems in this area. In addition, several demonstrations of the application of remote sensing technology to coastal zone management were described. These demonstrations were performed by several agencies in a variety of geographical areas. Author

**N76-17620\*** National Environmental Satellite Service, Washington, D.C.

**MARINE RESOURCES**

John W. Sherman, III /in NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 3 Jun. 1975 p 39-40

CSCL 08A

The papers presented in the marine session may be broadly grouped into several classes: microwave region instruments compared to infrared and visible region sensors, satellite techniques compared to aircraft techniques, open ocean applications compared to coastal region applications, and basic research and understanding of ocean phenomena compared to research techniques that offer immediate applications. Author

**N76-17701#** Army Cold Regions Research and Engineering Lab., Hanover, N.H.

**INTERPRETATION OF YOUNG ICE FORMS IN THE GULF OF ST. LAWRENCE USING SIDE-LOOKING AIRBORNE RADAR AND INFRARED IMAGERY**

Moir Dunbar and W. F. Weeks Jul. 1975 49 p refs (AD-A015457; CRREL-RR-337) Avail: NTIS CSCL 08/12

Ice conditions during mid-January 1974 in the Gulf of St. Lawrence and in the estuary as far upstream as Rimouski are described using side-looking airborne radar, infrared and photographic imagery. The interpretations were verified by simultaneous surface observations on the ice by investigators operating from the CSS Dawson. The ice examined was undergoing rapid drift and deformation and showed a wide variety of thin ice (0-40 cm) features formed under the influence of strong winds and currents. These observations should serve as a guide in interpreting ice conditions in similar areas where ground truth data are not available. GRA

## 05 OCEANOGRAPHY AND MARINE RESOURCES

**N76-18582\*#** Geological Survey, Tacoma, Wash.  
**SKYLAB FLOATING ICE EXPERIMENT Final Report**  
 W. J. Campbell, Principal Investigator, R. O. Ramseier (Dept. of the Environment, Ottawa, Canada), R. J. Weaver (Dept. of the Environment, Ottawa, Canada), and W. F. Weeks (Army Cold Regions Res. and Engr. Lab., Hanover, N. H.) Dec. 1975 67 p refs EREP  
 (NASA Order T-4111-B)  
 (E76-10161; NASA-CR-147446) Avail: NTIS HC \$4.50 CSCL 08L

The author has identified the following significant results. Coupling of the aircraft data with the ground truth observations proved to be highly successful with interesting results being obtained with IR and SLAR passive microwave techniques, and standard photography. Of particular interest were the results of the PMIS system which operated at 10.69 GHz with both vertical and horizontal polarizations. This was the first time that dual polarized images were obtained from floating ice. In both sea and lake ice, it was possible to distinguish a wide variety of thin ice types because of their large differences in brightness temperatures. It was found that the higher brightness temperature was invariably obtained in the vertically polarized mode, and as the age of the ice increases the brightness temperature increases in both polarizations. Associated with this change in age, the difference in temperature was observed as the different polarizations decreased. It appears that the horizontally polarized data is the most sensitive to variations in ice type for both fresh water and sea ice. The study also showed the great amount of information on ice surface roughness and deformation patterns that can be obtained from X-band SLAR observations.

**N76-18588\*#** Old Dominion Univ. Research Foundation, Norfolk, Va.

**THE USE OF ERTS-1 TO MORE FULLY UTILIZE AND APPLY MARINE STATION DATA TO THE STUDY AND PRODUCTIVITY ALONG THE EASTERN SHELF WATERS OF THE UNITED STATES Final Report, Aug. 1972 - Dec. 1974**

Harold G. Marshall, Principal Investigator, David E. Bowker (NASA, Langley Res. Center), and William G. Witté (NASA, Langley Res. Center) Feb. 1976 48 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Contract NAS5-21816)  
 (E76-10167; NASA-CR-146368) Avail: NTIS HC \$4.00 CSCL 08A

The author has identified the following significant results. Sea truth data were obtained during two ERTS overpasses in waters near the entrance of the Chesapeake Bay. Correlations were made between total phytoplankton and chlorophyll values in these waters to radiance detected by ERTS in an effort to map areas of similar productivity levels. Band 4 radiance had the highest correlation to all parameters with bands 5 and 6 showing decreasing correlations in each case. The radiance values were apparently influenced by one or more factors, most likely including the sediment content of the water. Data have shown that ERTS MSS is not suitable for monitoring chlorophyll in near-shore waters where sediment loads are high. It is suggested that in more seaward or pelagic locations, that ERTS MSS would be more efficient in monitoring surface chlorophyll values and establishing direct relationships to phytoplankton concentrations.

**N76-18612\*#** National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.  
**OCEAN PROPERTIES Final Report**  
 C. Laurence Korb and John F. Potter, Principal Investigators (Lockheed Electronic Corp., Houston) [1976] 98 p refs ERTS  
 (E76-10191; NASA-TM-X-72961) Avail: NTIS HC \$5.00 CSCL 08J

The author has identified the following significant results. Results of testing the CP program indicate that the best results can be obtained in the near infrared water bands. The absorption due to water vapor and carbon dioxide in the thermal infrared

band appeared to be less reliable in comparison to spacecraft-acquired data and band models. Comparisons of laboratory carbon dioxide transmission in the thermal infrared band show good agreement except in regions where lines are known to be missing. The comparison of ozone transmission at a wavelength of 9.6 micrometers to laboratory data showed unexceptionally large differences.

**N76-18769\*#** National Academy of Sciences - National Research Council, Washington, D.C.

**MARINE AND MARITIME USES Practical Applications of Space Systems**

1975 46 p refs

(Contract NSR-09-012-106)

(NASA-CR-146409; Paper-8) Avail: NTIS HC \$4.00; Space Applications Board, National Research Council, 2101 Constitution Avenue, N. W., Washington, D. C. 20418 CSCL 08J

Activities related to: (1) understanding, controlling, and using the ocean's biological and physical processes for food and energy production and ship design purposes, and (2) providing navigation, communication, and data transmission technological aids which improve efficiency and enhance safety in maritime operations are disclosed.

Author

**N76-19513\*#** Army Engineer District, San Francisco, Calif.  
**CALIFORNIA COAST NEARSHORE PROCESSES STUDY USING ERTS-B DATA Progress Report, 1 Dec. 1975 - 29 Feb. 1976**

Douglas M. Pirie and David D. Steller, Principal Investigators (ESCA-Tech Corp., Long Beach, Calif.) 17 Mar. 1976 2 p ERTS

(NASA Order S-54062-A)

(E76-10205; NASA-CR-146300) Avail: NTIS HC \$3.50 CSCL 08J

**N76-19515\*#** Norsk Polarinstittut, Oslo.  
**SEA ICE STUDIES IN THE SPITSBERGEN-GREENLAND AREA Quarterly Report**

Torgny E. Vinje, Principal Investigator Feb. 1976 10 p refs Sponsored by NASA and Royal Norwegian Council for Sci. and Indust. Res. Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(E76-10212; NASA-CR-146342; QR-2) Avail: NTIS HC \$3.50 CSCL 08L

The author has identified the following significant results. Data showed unexpected great variations in the drift velocity of the ice in the Fram Strait. Land map improvements were achieved by LANDSAT in the eastern part of the Svalbard archipelago.

**N76-19516\*#** Stockholm Univ. (Sweden).

**THE BALTIC SEA**

Bengt-Owe Jansson and Bo G. Nygvist, Principal Investigators 25 Feb. 1976 9 p Sponsored by NASA Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(E76-10213; NASA-CR-146343; Rept-2) Avail: NTIS HC \$3.50 CSCL 08A

**N76-19520\*#** JRB Associates, Ann Arbor, Mich.  
**USE OF SKYLAB EREP DATA IN A SEA-SURFACE TEMPERATURE EXPERIMENT Final Report, 17 Feb. 1973 - 1 Aug. 1975**

David C. Anding, Principal Investigator and John P. Walker Jul. 1975 54 p refs EREP

(Contract NAS9-13277)

(E76-10217; NASA-CR-144479; JRB-75-202-AA) Avail: NTIS HC \$4.50 CSCL 08J

The author has identified the following significant results. A sea surface temperature experiment was studied, demonstrating the feasibility of a procedure for the remote measurement of

sea surface temperature which inherently corrects for the effect of the intervening atmosphere without recourse to climatological data. The procedure was applied to Skylab EREP S191 spectrometer data, and it is demonstrated that atmospheric effects on the observed brightness temperature can be reduced to less than 1.0 K.

**N76-19547#** Tri-State Regional Planning Commission, New York.  
**THE TRI-STATE COASTAL ZONE MANAGEMENT PERSPECTIVES**

Apr. 1975 50 p refs Sponsored in part by Urban Mass Transportation Admin., Washington, D. C. and Dept. of Housing and Urban Develop., Washington, D. C.  
(PB-245658/O; TSRPC-2069) Avail: NTIS HC \$4.00 CSCL 13B

Tri-State has studied the impact of shipping, power generation, waste disposal and recreation on the coastal area, and urges the Region to accommodate the essential economic, cultural and leisure needs of its people there, and to guard, restore or enhance the natural character of the coastal zone. Although the three states of the Tri-State Region are becoming increasingly involved in wetlands preservation, water and air resources planning and control, and in regulating uses of shore areas, the Commission recommends the establishment of a new management mechanism, which would be guided by the need to combine coastal zone uses with resource continuance and renewal. GRA

**N76-19672\*#** Transemanatics, Inc., Washington, D.C.  
**CERTAIN CHARACTERISTICS OF THE VERTICAL STRUCTURE OF THE AREA OF MOISTURE DURING VARIOUS PRECIPITATIONS**

Ye. P. Dombkovskaya, M. V. Bobrova, and V. V. Ozerkina NASA Mar. 1976 18 p refs Transl. into ENGLISH from Tr. no. 148, Hydrometeorol. Sci. Res. Center (Leningrad), 1974 p 102-114 (Contract NASw-2792)  
(NASA-TT-F-16935) Avail: NTIS HC \$3.50 CSCL 04B

Weather ships stationed in the North Atlantic were used to study the vertical structure of the humidity field. The humidity field was studied both in clear and cloudy weather. Cloudy weather accompanied by drizzle, steady rain, and downpours was chosen for the investigation. Author

**N76-19707** Colorado Univ., Boulder. Inst. of Arctic and Alpine Research.

**THE LAURENTIDE ICE SHEET: PROBLEMS OF THE MODE AND SPEED OF INCEPTION**

J. T. Andrews, R. G. Barry, P. T. Davis, A. S. Dyke, M. Mahaffy, L. D. Williams, and C. Wright In WMO Long-term Climatic Fluctuations 1975 p 87-94 refs

(Grant NSF GA-40248)  
Copyright.

The growth rate and development of the Laurentide Ice Sheet are briefly described followed by a discussion of the extent of late Neoglacial snow cover over northern Baffin Island as an example of an 'abortive' glaciation. The change in snowline between the present day and the late Neoglacial era as an indication of the sensitivity of the upland plateaux of the eastern Canadian Arctic to small-scale climatic shifts is discussed. The use of a three-dimensional numerical ice flow model to conduct an experiment on the growth rate of the Laurentide Ice Sheet is also described. ESA

**N76-19764\*#** Kanner (Leo) Associates, Redwood City, Calif.  
**EFFECTIVE APPLICATION OF CONTINUOUS MEASUREMENT TO OBJECTIVE ANALYSIS OF PHYSICAL FIELDS OF THE OCEAN**

G. A. Moiseyev Washington NASA Mar. 1976 18 p refs Transl. into ENGLISH from Akad. Nauk Ukr. SSR, Morskiye Gidrofiz. Issled. (USSR), no. 1, 1974 p 118-130 (Contract NASw-2790)  
(NASA-TT-F-16917) Avail: NTIS HC \$3.50 CSCL 08C

A spectral density approach with an optimum interpolation method is used to develop an algorithm, which permits the use of measurement of a random, homogeneous field along parallel profiles. Correlations are developed for obtaining the dependence of the field reconstruction error on the distances between the profiles. A comparison is made with methods previously used, and the proposed method generally makes it possible to solve problems of planning measurements of physical fields in the ocean more effectively. Author

**N76-20604\*#** Norsk Polarinstitutt, Oslo.  
**GLACIOLOGICAL AND MARINE BIOLOGICAL STUDIES AT PERIMETER OF DRONNING MAUD LAND, ANTARCTICA**  
**Quarterly Progress Report**

Olav Orheim, Principal Investigator 24 Mar. 1976 4 p Sponsored by NASA and Royal Norwegian Council for Sci. and Industrial Res. ERTS  
(E76-10258; NASA-CR-146630; QPR-2) Avail: NTIS HC \$3.50 CSCL 08A

**N76-20608\*#** Texas Univ., Austin.  
**DEVELOPMENT AND APPLICATION OF OPERATIONAL TECHNIQUES FOR THE INVENTORY AND MONITORING OF RESOURCES AND USES FOR THE TEXAS COASTAL ZONE** Quarterly Report, Dec. - Feb. 1976

Ron Jones, Principal Investigator (General Land Office, Austin, Tex.), Peggy Harwood (General Land Office, Austin, Tex.), Robert Finley, George Clements (Texas Parks and Wildlife Dept., Austin), Larry Lodwick (Texas Parks and Wildlife Dept., Austin), Samuel McCulloch (Texas Water Development Board, Austin), and David Murphy (Texas Water Development Board, Austin) Mar. 1976 56 p refs ERTS  
(Contract NAS5-20986)  
(E76-10263; NASA-CR-146635) Avail: NTIS HC \$4.50 CSCL 08C

The author has identified the following significant results. The most significant ADP result was the modification of the DAM package to produce classified printouts, scaled and registered to U.S.G.S., 7 1/2 minute topographic maps from LARSYS-type classification files. With this modification, all the powerful scaling and registration capabilities of DAM become available for multiclass classification files. The most significant results with respect to image interpretation were the application of mapping techniques to a new, more complex area, and the refinement of an image interpretation procedure which should yield the best results.

**N76-20618#** National Oceanic and Atmospheric Administration, Boulder, Colo. Atmospheric Physics and Chemistry Lab.  
**AIRBORNE INFRARED IMAGERY OF ARCTIC SEA ICE THICKNESS**

P. M. Kuhn, L. P. Sterns, and R. O. Ramjeier May 1975 23 p refs  
(PB-246426/1; NOAA-TR-ERL-331; NOAA-75101401) Avail: NTIS HC \$3.50 CSCL 08L

An empirically observed correlation between ice thickness and infrared brightness ice temperature, based on heat transfer and heat flux at the sea-ice and sea-air interfaces is presented. GRA

**N76-20619#** National Oceanic and Atmospheric Administration, Boulder, Colo. Environmental Research Labs.  
**AN EVALUATION OF THE USE OF THE EARTH RESOURCES TECHNOLOGY SATELLITE FOR OBSERVING OCEAN CURRENT BOUNDARIES IN THE GULF STREAM SYSTEM**  
George A. Maul Jan. 1975 130 p  
(PB-246932/8; NOAA-TR-ERL-335; AOML-18; NOAA-75101402) Avail: NTIS HC \$6.00 CSCL 08C

Remote sensing of ocean color to locate current boundaries was tested in the eastern Gulf of Mexico. A 1-year time history of the Gulf Loop Current was made by a ship in synchronization with the Earth Resources Technology Satellite (ERTS). Surface chlorophyll-a, temperature, and scattering observations show that

## 05 OCEANOGRAPHY AND MARINE RESOURCES

color signature of the current is present when thermal indications are absent, and thus this flow can potentially be monitored by a combination of visible and infrared techniques. GRA

**N76-20794#** Informatics, Inc., Rockville, Md.  
**BIBLIOGRAPHY OF SOVIET MATERIAL ON INTERNAL WAVES, NUMBER 4, JANUARY - MAY 1975**  
 Stuart G. Hibben, L. H. Boylan, and M. Ness 6 Jun. 1975  
 22 p refs  
 (Contract N00600-75-C-0018; DARPA Order 2790)  
 (AD-A010858) Avail: NTIS CSCL 08/3

This is the fourth bibliography of Soviet open-source publications relating to internal wave studies. It covers material received from January through May 1975. Main selection criteria are studies of small-scale variation in ocean parameters and of airborne techniques for deducing internal wave conditions. An index of serial source abbreviations is appended. GRA

**N76-21633\*#** Virginia Univ., Charlottesville. Dept. of Environmental Sciences.  
**SHORELINE CONFIGURATION AND SHORELINE DYNAMICS: A MESOSCALE ANALYSIS**  
 R. Dolan, Principal Investigator, B. P. Hayden, and J. E. Heywood [1975] 22 p refs ERTS  
 (Contract NAS5-20999)  
 (E76-10266; NASA-CR-146567) Avail: NTIS HC \$3.50 CSCL 08J

The author has identified the following significant results. Atlantic coast barrier island shorelines are seldom straight, but rather sinuous. These shoreline curvatures range in size from cusps to capes. Significant relationships exist between the orientation of shoreline segments within the larger of these sinuous features and shoreline dynamics, with coefficients ranging up to .9. Orientation of the shoreline segments of Assateague Island (60 km) and the Outer Banks of North Carolina (130 km) was measured from LANDSAT 2 imagery (1:80,000) and high altitude aerial photography (1:120,000). Long term trends in shoreline dynamics were established by mapping shoreline and storm-surge penetration changes.

**N76-21647\*#** Division of National Mapping, Canberra (Australia).  
**MAPPING ISLANDS, REEFS AND SHOALS IN THE OCEANS SURROUNDING AUSTRALIA Quarterly Report, 8 Nov. 1975 : 8 Feb. 1976**  
 Léonard G. Turner, Principal Investigator 8 Feb. 1976 4 p  
 Sponsored by NASA ERTS  
 (E76-10280; NASA-CR-146650; QR-2) Avail: NTIS HC \$3.50 CSCL 08B

The author has identified the following significant results. Two geometric distortion tests of the same scene using different ground control identification methods have produced different estimates of the magnitude of geometric distortions of the image frame. A comparison of imagery with hydrographic charts shows that the imagery displays shoals and reefs which are close to the water surface. Such information can be used during the compilation of new maps of such regions, in the checking of existing hydrographic charts, or for navigation warning.

**N76-21648\*#** Ecole Pratique des Hautes Etudes, Paris (France).  
**THE FRENCH ATLANTIC LITTORAL AND THE MASSIF ARMORICAIN Progress Report, Jan. - Mar. 1976**  
 Fernand Verger, Principal Investigator, Jean-Marie Monget, and Jean-Yves Scanvic Mar. 1976 28 p refs Sponsored by NASA and CNS Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS  
 (E76-10281; NASA-CR-146651; Rept-2) Avail: NTIS HC \$4.00 CSCL 08E

The author has identified the following significant results. Diachronic use of LANDSAT data time series will in time allow study of statistically submerged frequencies in tidal areas. This is an essential element of coastal geomorphology and of coastal zone management, being particularly useful in siting shellfish

farms. Maps at useable scales and simple user oriented legends should become an essential document for coastal planning agencies.

**N76-21652\*#** Alaska Univ., Anchorage.  
**LANDSAT SURVEY OF NEAR-SHORE ICE CONDITIONS ALONG THE ARCTIC COAST OF ALASKA Progress Report**  
 William J. Stringer, Principal Investigator [1975] 54 p  
 Sponsored by NASA ERTS  
 (E76-10285; NASA-CR-146655; QPR-4) Avail: NTIS HC \$4.50 CSCL 08L

**N76-21849#** Calspan Corp., Buffalo, N.Y.  
**MARINE FOG STUDIES OFF THE CALIFORNIA COAST Annual Summary Report**  
 Eugene J. Mack, Roland J. Pillie, and Ulrich Katz Mar. 1975  
 87 p refs  
 (Contract N00019-75-C-0053)  
 (AD-A016958; CALSPAN-CJ-5607-M-1; ASR-3) Avail: NTIS CSCL 04/2

Contents: Summary of marine fog occurrence off the West Coast; The importance of organized vertical motions in coastal fog; Bay fog (marine fog formation through continental influences); Observations of a mesoscale organization of fog occurrence off the West Coast. GRA

**N76-21867#** Rosenstiel School of Marine and Atmospheric Sciences, Miami, Fla.  
**COASTAL UPWELLING EXPERIMENT. 2: HYDROGRAPHIC DATA, REPORT. R/V YAQUINA CRUISES Y7307-B AND Y7308-A (15-18 JULY AND 16-20 AUGUST 1973). R/V CAYUSE CRUISE C7308-E (18-31 AUGUST 1973)**  
 Thomas B. Curtin, Walter R. Johnson, and Christopher N. K. Mooers Jan. 1975 105 p refs  
 (Grant NSF GX-31264)  
 (PB-248189/3; UMRSAS-75003; NSF/IDOE-75-76) Avail: NTIS HC \$5.50 CSCL 08C

The report includes data from two cruises of the R/V YAQUINA and one cruise of the R/V CAYUSE during the summer of 1973. The purpose of these cruises was to make detailed hydrographic and current profiles in a coastal upwelling frontal zone. Several modes of operation were implemented during the three cruises. High resolution (both horizontal and vertical) cross sections; alongshore mapping patterns; fixed location time series analysis inshore, small-scale cross sections; and fixed position moorings were all used in the effort to examine the details of the coastal upwelling mesoscale processes. GRA

## HYDROLOGY AND WATER MANAGEMENT

Includes snow cover and water runoff in rivers and glaciers, saline intrusion, drainage analysis, geomorphology of river basins, land uses, and estuarine studies.

**A76-19336** Great Lakes temperature maps by satellite /IFYGL/. A. E. Strong (NOAA, National Environmental Satellite Service, Suitland, Md.). *International Association for Great Lakes Research, Annual Conference, 17th, Hamilton, Ontario, Canada, Aug. 12-14, 1974, Paper.* 13 p. 8 refs.

Five case studies using Very High Resolution Radiometer data from the NOAA-2 satellite are presented. They demonstrate a capability for monitoring surface temperatures of the Great Lakes from space. Comparisons of these data with data available from more conventional sources are used to illustrate: (1) isothermal conditions, (2) thermal-bar circulations, (3) diurnal variability, and (4) summer upwelling. Examples presented show the potential for using satellite observations routinely to monitor surface temperatures of the Great Lakes. (Author)

**A76-19337 \*** Selected satellite data on snow and ice in the Great Lakes basin 1972-73 /IFYGL/. D. R. Wiesnet, D. F. McGinnis, and D. G. Forsyth (NOAA, National Environmental Satellite Service, Suitland, Md.). *International Association for Great Lakes Research, Annual Conference, 17th, Hamilton, Ontario, Canada, Aug. 12-14, 1974, Paper.* 14 p. 5 refs. NOAA-supported research; NASA Contract No. 432-641-14-04-03.

Three snow-extent maps of the Lake Ontario drainage basin were prepared from NOAA-2 satellite visible band images during the International Field Year for the Great Lakes. These maps are discussed and the satellite data are evaluated for snow-extent mapping. The value of ERTS-1 imagery and digital data is also discussed in relation to the Lake Ontario basin studies. ERTS-1 MSS data are excellent for ice identification and analysis but are not useful for forecasting where timely receipt of data is imperative. NOAA-2 VHRR data are timely but the lower resolution of the VHRR makes identification of certain ice features difficult. NOAA-2 VHRR is well suited for snow-extent maps and thermal maps of large areas such as the 19,000 sq-km Lake Ontario basin. (Author)

**A76-23499 \*** Electromagnetic reflection from multi-layered snow models. W. I. Linlor (NASA, Ames Research Center, Moffett Field, Calif.) and G. R. Jiracek (New Mexico, University, Albuquerque, N. Mex.). *Journal of Glaciology*, vol. 14, no. 72, 1975, p. 501-515. 16 refs.

The remote sensing of snow-pack characteristics with surface installations or an airborne system could have important applications in water-resource management and flood prediction. To derive some insight into such applications, the electromagnetic response of multilayered snow models is analyzed in this paper. Normally incident plane waves at frequencies ranging from 1 MHz to 10 GHz are assumed, and amplitude reflection coefficients are calculated for models having various snow-layer combinations, including ice layers. Layers are defined by thickness, permittivity, and conductivity; the electrical parameters are constant or prescribed functions of frequency. To illustrate the effect of various layering combinations, results are given in the form of curves of amplitude reflection coefficients versus frequency for a variety of models. Under simplifying assumptions, the snow thickness and effective dielectric constant can be estimated from the variations of reflection coefficient as a function of frequency. (Author)

**A76-28080** Prospecting for ground-water with SKYLAB photographs, central Tennessee. G. K. Moore (U.S. Geological Survey, Bay St. Louis, Mo.) and E. F. Hollyday (U.S. Geological Survey, Nashville, Tenn.). In: Remote sensing of earth resources. Volume 4 - Proceedings of the Fourth Annual Conference on Earth Resources, Tullahoma, Tenn., March 24-26, 1975.

Tullahoma, University of Tennessee, 1975, p. 499-519.

The test site (5,550 square kilometres) in central Tennessee is underlain by dense, flat-lying limestones. Ground water occurs in solution cavities and the trends of these cavities generally are controlled by joints. Most fracture traces and lineaments visible on aerial photographs also are caused by joints. This study tests the hypothesis that the chances of obtaining relatively large yields of ground water are best at sites on or near lineaments detected on SKYLAB photography. S-190B photographs were examined both by stereo viewing and by projection viewing, and all visible lineaments were mapped. Wells located near lineaments detected by both methods generally have larger yields than those located randomly. Yields of wells near lineaments detected on SKYLAB photographs generally are larger than those on lineaments detected on either ERTS imagery or high-altitude aerial photographs. (Author)

**A76-28082** Color measurements and suspended sediments in north Mississippi reservoirs. F. R. Schiebe and J. C. Ritchie (U.S. Department of Agriculture, Sedimentation Laboratory, Oxford, Miss.). In: Remote sensing of earth resources. Volume 4 - Proceedings of the Fourth Annual Conference on Earth Resources, Tullahoma, Tenn., March 24-26, 1975. Tullahoma, University of Tennessee, 1975, p. 543-553. 6 refs.

The solar radiation spectra reflected from north Mississippi reservoirs have been analyzed according to the CIE system for the quantitative description of color. This analysis results in the determination of trichromatic coefficients which when plotted on a chromaticity diagram yield a dominant wavelength of color and the color purity. These parameters have been related to in situ measurements of suspended sediments in north Mississippi reservoirs. A quantitative relationship was determined for concentrations of suspended sediments in the range 15-100 ppm. (Author)

**A76-28083** Sun angle, reflected solar radiation and suspended sediments in north Mississippi reservoirs. J. C. Ritchie, F. R. Schiebe, R. B. Wilson, and J. May (U.S. Department of Agriculture, Agricultural Research Service, Oxford, Miss.). In: Remote sensing of earth resources. Volume 4 - Proceedings of the Fourth Annual Conference on Earth Resources, Tullahoma, Tenn., March 24-26, 1975. Tullahoma, University of Tennessee, 1975, p. 555-564. 13 refs.

In situ measurements were made of the incident and reflected solar radiation from the surface waters of 6 reservoirs in North Mississippi using a spectroradiometer. Solar radiation measurements were made at 25 nm intervals from 400 to 750 nm and at 50 nm intervals from 750 to 1550 nm from August 1973 through October 1974. As sun angle (deviation from zenith) increased the correlation coefficient for the linear relationship between both reflected solar radiation and reflectance and total suspended solids decreased. Sun angle affected the relationship between suspended solids and reflectance measurements more than it does the relationship between suspended solids and reflected solar radiation. The total suspended solids in the surface water had a greater effect on the amount of reflected solar radiation than sun angle. (Author)

**A76-28084 \*** Quantitative sediment mapping from remotely sensed multispectral data. R. W. Johnson (NASA, Langley Research Center, Hampton, Va.). In: Remote sensing of earth resources. Volume 4 - Proceedings of the Fourth Annual Conference on Earth Resources, Tullahoma, Tenn., March 24-26, 1975. (A76-28083) Tullahoma, University of Tennessee, 1975, p. 565-576.

Multiple regression techniques were used to correlate ERTS-1 data with measured values of suspended sediment. The resultant equation was applied to a different ERTS scene using a deepwater area for atmospheric calibration. This approach provides greater



## 06 HYDROLOGY AND WATER MANAGEMENT

accuracy than previously reported methods. Suspended sediment contours are plotted for the Potomac River, Virginia, using Chesapeake Bay deep water for atmospheric calibration. (Author)

**N76-16514\*#** Texas A&M Univ., College Station. Remote Sensing Center.

**SPECTRAL MEASUREMENT OF WATERSHED COEFFICIENTS IN THE SOUTHERN GREAT PLAINS** Progress Report, Aug. - Nov. 1975

Bruce J. Blanchard, Principal Investigator Jan. 1976 12 p ERTS

(Contract NAS5-22534)

(E76-10091; NASA-CR-145994; RSC-3273-1) Avail: NTIS HC \$3.50 CSCL 08H

**N76-16515\*#** Norsk Polarinstitutt, Oslo.

**GLACIOLOGICAL AND MARINE BIOLOGICAL STUDIES AT PERIMETER OF DRONNING MAUD LAND, ANTARCTICA** Quarterly Report

Olav Orheim, Principal Investigator 11 Nov. 1975 4 p Sponsored by NASA ERTS

(E76-10092; NASA-CR-145995; QR-1) Avail: NTIS HC \$3.50 CSCL 08A

**N76-16520\*#** Geological Survey, Reston, Va.

**THE DELAWARE RIVER BASIN LANDSAT DATA COLLECTION SYSTEM EXPERIMENT** Final Report

Richard W. Paulson, Principal Investigator Nov. 1975 44 p refs ERTS

(NASA Order S-70243-AG)

(E76-10097; NASA-CR-146030) Avail: NTIS HC \$4.00 CSCL 08H

The author has identified the following significant results. This experiment successfully demonstrated that standard U.S. Geological Survey field instrumentation could be easily interfaced with the LANDSAT-DCS and the data made to flow smoothly to water resources management agencies. The experiment was conducted in the Delaware River basin. A truly operational system could not be deployed.

**N76-16528\*#** Delaware Univ., Newark.

**A COST-EFFECTIVE SATELLITE-AIRCRAFT-DROGUE APPROACH FOR STUDYING ESTUARINE CIRCULATION AND SHELF WASTE DISPERSION**

V. Klemas, Principal Investigator, G. Davis, H. Wang, W. Whelan (ITT Electro-Physics Labs., Inc.), and G. Tornatore (ITT Electro-Physics Labs., Inc.) [1975] 11 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Contracts NAS5-21837; N00014-69-A-0407)

(E76-10105; NASA-CR-146038; CMS-NASA-5-75) Avail: NTIS HC \$3.50 CSCL 08J

The author has identified the following significant results. Satellites, such as ERTS-1, can be used to obtain a synoptic view of current circulation over large coastal areas. Since in turbid coastal regions suspended sediment acts as a natural tracer, cost is minimized by eliminating the need for expensive injections of large volumes of dye such as Rhodamine-B. One of the principal shortcomings of satellite imaging of coastal currents was its inability to determine current magnitude and to penetrate beyond the upper few meters of the water column. These objections were overcome by complementing satellite observations with drogues tracking currents at various selected depths. By combining the satellite's wide coverage with aircraft or shore stations capable of tracking expendable drogues, a cost effective, integrated system was devised for monitoring currents over large areas, various depths, and under severe environmental conditions.

**N76-16531\*#** California State Dept. of Water Resources, Sacramento.

**[U2 AND ERTS IMAGERY OF LAKE TAHOE AND SAN FRANCISCO BAY DELTA]** Progress Report

Randall L. Brown, Principal Investigator Oct. 1975 2 p ERTS (Contract NAS5-20945)

(E76-10108; NASA-CR-146041; QPR-1) Avail: NTIS HC \$3.50 CSCL 08H

**N76-16536\*#** Army Engineer District, San Francisco, Calif. **CALIFORNIA COAST NEARSHORE PROCESSES STUDY USING ERTS-B DATA** Progress Report, 1 Sep. - 30 Nov. 1975

Douglas M. Pirie and David D. Steller, Principal Investigators (ESCA-Tech. Corp., Long Beach, Calif.) 10 Dec. 1975 2 p ERTS

(E76-10113; NASA-CR-146046) Avail: NTIS HC \$3.50 CSCL 08J

**N76-16538\*#** Virginia Univ., Charlottesville.

**LANDSAT APPLICATION OF REMOTE SENSING TO SHORELINE-FORM ANALYSIS** Quarterly Report, 4 Mar. 1975 - 6 Feb. 1976

Robert Dolan, Principal Investigator and Jeffrey Heywood 2 Dec. 1975 7 p ERTS

(Contract NAS5-20999)

(E76-10115; NASA-CR-146048) Avail: NTIS HC \$3.50 CSCL 08J

The author has identified the following significant results. Areas of the coast were selected which have historically shown vulnerability to storm damage. On Assateague Island, there are six such areas: the western tip of Fishing Point; the southern National Park Service parking lot; Smith Hammocks; Fox Hill Level; Little Fox Hill Level; and the northern five kilometers of the island. Comparative analysis of these areas with other data and with large and small scale aerial photographs shows them to be associated with large overwash fans and shoreline cusping. Initial analysis of Landsat imagery and high altitude photography indicates that the areas of high vulnerability are also associated with the angular orientation of the shoreline.

**N76-16545\*#** Bendix Corp., Ann Arbor, Mich. Aerospace Systems Div.

**APPLICATION OF LANDSAT TO THE SURVEILLANCE AND CONTROL OF LAKE EUTROPHICATION IN THE GREAT LAKES BASIN** Progress Report, Nov. 1975 - Jan. 1976

Robert H. Rogers, Principal Investigator Jan. 1976 25 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Contract NAS5-20942)

(E76-10122; NASA-CR-146055) Avail: NTIS HC \$3.50 CSCL 08H

**N76-16547\*#** Bendix Corp., Ann Arbor, Mich. Aerospace Systems Div.

**COMPUTER MAPPING OF WATER QUALITY IN SAGINAW BAY WITH LANDSAT DIGITAL DATA** Special Report

R. H. Rogers, Principal Investigator, N. J. Shah, V. E. Smith, and J. B. McKeon Jan. 1976 15 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Contract NAS5-20942)

(E76-10124; NASA-CR-146057; BSR-4213) Avail: NTIS HC \$3.50 CSCL 08H

The author has identified the following significant results. LANDSAT digital data and ground truth measurements for Saginaw Bay (Lake Huron), Michigan, for 31 July 1975 were correlated by stepwise linear regression and the resulting equations used to estimate invisible water quality parameters in nonsampled areas. Chloride, conductivity, total Kjeldahl nitrogen, total phosphorus, and chlorophyll a were best correlated with the

ratio of LANDSAT Band 4 to Band 5. Temperature and Secchi depth correlate best with Band 5.

**N76-16561\*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

## **OPERATIONAL APPLICATIONS OF SATELLITE SNOWCOVER OBSERVATIONS**

Albert Rango, ed. Washington 1975 430 p refs Proc. held at South Lake Tahoe, Calif., 18-20 Aug. 1975; sponsored by NASA and Nevada Univ.

(NASA-SP-391) Avail: NTIS HC \$11.75 CSCL 08L

LANDSAT and NOAA satellites data were used to study snow depth. These snow measurements were used to help forecast runoff and flooding. Many areas of California, Arizona, Colorado, and Wyoming were emphasized.

**N76-16562\*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

## **AN OVERVIEW OF THE APPLICATIONS SYSTEMS VERIFICATION TEST ON SNOWCOVER MAPPING**

A. Rango In its Operational Appl. of Satellite Snowcover Observations 1975 p 1-12 refs

(Paper-1) CSCL 08L

The capability of the LANDSAT and NOAA satellites to accurately measure snowcovered area on various size watersheds was demonstrated. Recent research has shown a highly significant statistical relationship between satellite-derived snowcovered area at the beginning of the snowmelt period and seasonal runoff. The decision was made to test the results of several satellite snowcovered area studies in an Applications Systems Verification Test (ASVT) Program where quasi-operational evaluations of total technical capability are performed. The objective of these ASVT's is to provide all the information necessary for a potential user to make effective decisions concerning the implementation of the new remote sensing technology in an operational applications system.

Author

**N76-16563\*** Geological Survey, Phoenix, Ariz.

## **OPERATIONAL APPLICATIONS OF SATELLITE SNOWCOVER OBSERVATIONS AND LANDSAT DATA COLLECTION SYSTEMS OPERATIONS IN CENTRAL ARIZONA**

Herbert H. Schumann In NASA. Goddard Space Flight Center Operational Appl. of Satellite Snowcover Observations 1975 p 13-28 refs

(Paper-2) CSCL 08L

Repetitive LANDSAT and NOAA-4 satellite imagery together with aerial surveys are being evaluated to develop an operational capability for mapping snowcover distributions on the Salt-Verde watershed of central Arizona. Satellite telemetry is also being used for near-real time relay of hydrologic data to aid in the management and operation of reservoirs on the Salt and Verde Rivers. Aerial reconnaissance flights were conducted to collect information on the depth and distribution of snowcover to provide ground truth for use in the analysis of the satellite imagery. A technique for rapid and economical determination of snow depths, using oblique aerial photography of snow markers, was developed.

Author

**N76-16564\*** Salt River Project, Phoenix, Ariz.

## **THE APPLICATION OF HYDROMETEOROLOGICAL DATA OBTAINED BY REMOTE SENSING TECHNIQUES FOR MULTIPURPOSE RESERVOIR OPERATIONS**

W. L. Warskow, T. T. Wilson, Jr., and K. Kirdar In NASA. Goddard Space Flight Center Operational Appl. of Satellite Snowcover Observations 1975 p 29-37 refs

(Paper-3) CSCL 08L

Watershed snowpack and streamflow data obtained and transmitted by (ERTS) satellite were used in the operational and water management decisions in the Salt River Project. Located in central Arizona, the Project provides water and electric power for the more than 1.1 million residents of the Salt River Valley. The water supply source is a 33,670 square kilometer (13,000

square mile) watershed and 250 deep well pumps. Six storage reservoirs, four of which have hydroelectric capability, located on two river systems have a storage capacity of over 246,600 hectare-meters (2,000,000 AF.). Information from the watershed during the normal runoff period of December to May and more especially during critical periods of high runoff and minimum reservoir storage capacity is necessary for the reservoir operation regimen. Extent of the snowpack, depth of snow, and the condition of the pack were observed in aerial flights over the watershed.

Author

**N76-16565\*** Sierra Hydrotech, Placerville, Calif.

## **INTERPRETATION OF SNOWCOVER FROM SATELLITE IMAGERY FOR USE IN WATER SUPPLY FORECASTS IN THE SIERRA NEVADA**

A. J. Brown (California Dept. of Water Resources, Sacramento) and J. F. Hannaford In NASA. Goddard Space Flight Center Operational Appl. of Satellite Snowcover Observations 1975 p 39-51

(Paper-4) CSCL 08L

The California ASVT test area is composed of two study areas; one in Northern California covering the Upper Sacramento and Feather River Basins, and the other covering the Southern Sierra Basins of the San Joaquin, Kings, Kaweah, Tule, and Kern Rivers. Experiences of reducing snowcover from satellite imagery; the accuracy of present water supply forecast schemes; and the potential advantages of introducing snowcover into the forecast procedures are described.

Author

**N76-16566\*** Soil Conservation Service, Denver, Colo.

## **OPERATIONAL APPLICATIONS OF SATELLITE SNOWCOVER OBSERVATIONS IN RIO GRANDE DRAINAGE OF COLORADO**

Jack N. Washcheck and Tony Mikesell In NASA. Goddard Space Flight Center Operational Appl. of Satellite Snowcover Observations 1975 p 53-69

(Paper-5) CSCL 08L

Various mapping techniques were tried and evaluated. There were many problems encountered such as distinguishing clouds from snow and snow under trees. A partial solution to some of the problems involves ground reconnaissance and low air flights. Snow areas, cloud cover, and total areas were planimetered after transferring imagery by use of zoom transfer scope. These determinations were then compared to areas determined by use of a density slicer. Considerable adjustment is required for these two values to compare. NOAA pictures were also utilized in the evaluation. Forest cover is one of the parameters used in the modeling process. The determination of this percentage is being explored.

Author

**N76-16567\*** Bonneville Power Administration, Portland, Oreg. Hydrology Section.

## **OPERATIONAL APPLICATION OF SATELLITE SNOWCOVER OBSERVATIONS, NORTHWEST UNITED STATES**

Fred A. Limpert In NASA. Goddard Space Flight Center Operational Appl. of Satellite Snowcover Observations 1975 p 71-85 refs

(Paper-6) CSCL 08L

A demonstration project was undertaken in the Pacific Northwest to determine the applicability of satellite snowcover observations for operational use in three test areas of the Columbia River Basin.

Author

**N76-16568\*** National Oceanic and Atmospheric Administration, Washington, D.C.

## **THE OPERATIONAL PROGRAM OF SATELLITE SNOWCOVER OBSERVATIONS AT NOAA/NESS**

Stanley R. Schneider In NASA. Goddard Space Flight Center Operational Appl. of Satellite Snowcover Observations 1975 p 87-101 refs

(Paper-7) CSCL 08L

The operational river basin snow mapping program at NESS is described with emphasis on quality control techniques and results for the 1974-1975 snow season.

Author

## 06 HYDROLOGY AND WATER MANAGEMENT

**N76-16569\*** Arizona Univ., Tucson.

### **USE OF AREAL SNOW COVER MEASUREMENTS FROM ERTS-1 IMAGERY IN SNOWMELT-RUNOFF RELATIONSHIPS IN ARIZONA**

J. S. Aul and P. F. Ffolliott / In NASA. Goddard Space Flight Center Operational Appl. of Satellite Snowcover Observations 1975 p 103-112 refs  
(Paper-8) CSCL 08L

Methods of interpreting ERTS-1 imagery to measure areal snow cover were analyzed. Relationship of areal snow cover and runoff were among the objectives in this study of ERTS-1 imagery use for forecasting snowmelt-runoff relationships. Author

**N76-16570\*** Wyoming Univ., Laramie.

### **UTILIZATION OF LANDSAT MONITORING CAPABILITIES FOR SNOWCOVER DEPLETION ANALYSIS**

A. G. Thompson / In NASA. Goddard Space Flight Center Operational Appl. of Satellite Snowcover Observations 1975 p 113-127 refs  
(Paper-9) CSCL 08L

LANDSAT images for three snowmelt seasons were utilized to map and analyze snowcover depletion on a small river basin in southeastern Wyoming. Results indicate that snowcover-runoff curves established from repetitive LANDSAT coverage may be used in conjunction with streamflow data to provide low-cost seasonal runoff forecasts having a high degree of accuracy. Additionally, detectable variations within a snowpack might provide temporal estimates of peak flows. Author

**N76-16571\*** California Univ., Berkeley.

### **OPERATIONAL USE OF LANDSAT IMAGERY FOR THE ESTIMATION OF SNOW AREAL EXTENT**

Edwin F. Katibah / In NASA. Goddard Space Flight Center Operational Appl. of Satellite Snowcover Observations 1975 p 129-142 refs  
(Grant NGL-05-003-404)  
(Paper-10) CSCL 08L

Quantification of the surface area of snow covering watersheds can be a useful parameter in estimating snow water content for inclusion in water runoff prediction equations. An operational manual interpretation technique is described, which allows fast and accurate estimates to be made of the areal extent of snow parameter using LANDSAT-1 imagery. The analysis procedures and the statistical results are presented. Author

**N76-16573\*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

### **EMPLOYMENT OF SATELLITE SNOWCOVER OBSERVATIONS FOR IMPROVING SEASONAL RUNOFF ESTIMATES**

A. Rango, V. V. Salomonson, and J. L. Foster (Maryland Univ., College Park) / In its Operational Appl. of Satellite Snowcover Observations 1975 p 157-174 refs Sponsored in part by NOAA  
(Paper-12) CSCL 08L

Low resolution meteorological satellite and high resolution earth resources satellite data were used to map snowcovered area over the upper Indus River and the Wind River Mountains of Wyoming, respectively. For the Indus River, early Spring snowcovered area was extracted and related to April through June streamflow from 1967-1971 using a regression equation. Composited results from two years of data over seven Wind River Mountain watersheds indicated that LANDSAT-1 snowcover observations, separated on the basis of watershed elevation, could also be related to runoff in significant regression equations. It appears that earth resources satellite data will be useful in assisting in the prediction of seasonal streamflow for various water resources applications, nonhazardous collection of snow data from restricted-access areas, and in hydrologic modeling of snowmelt runoff. Author

**N76-16574\*** Leaf (Charles F.), Fort Collins, Colo.

### **APPLICATIONS OF SATELLITE SNOW COVER IN COMPUTERIZED SHORT-TERM STREAMFLOW FORECASTING**

C. F. Leaf / In NASA. Goddard Space Flight Center Operational

Appl. of Satellite Snowcover Observations 1975 p 175-186 refs Sponsored by USDA  
(Paper-13) CSCL 08L

A procedure is described whereby the correlation between: (1) satellite derived snow-cover depletion and (2) residual snowpack water equivalent, can be used to update computerized residual flow forecasts for the Conejos River in southern Colorado. Author

**N76-16575\*** National Environmental Satellite Service, Suitland, Md.

### **SIERRA NEVADA SNOW MELT FROM SMS-2**

Laurence C. Breaker (NOAA, Redwood City, Calif.) and Michael C. McMillan / In NASA. Goddard Space Flight Center Operational Appl. of Satellite Snowcover Observations 1975 p 187-197 refs  
(Paper-14) CSCL 08L

A film loop from SMS-2 imagery shows snow melt over the Sierra Nevadas from May 10 to July 8, 1975. The sequence indicates a successful application of geostationary satellite data for monitoring dynamic hydrologic conditions. Author

**N76-16576\*** Environmental Research and Technology, Inc., Concord, Mass.

### **SYNOPSIS OF CURRENT SATELLITE SNOW MAPPING TECHNIQUES, WITH EMPHASIS ON THE APPLICATION OF NEAR-INFRARED DATA**

James C. Barnes and Michael D. Smallwood / In NASA. Goddard Space Flight Center Operational Appl. of Satellite Snowcover Observations 1975 p 199-213 refs

(Contract NAS9-13305)

(Paper-15) CSCL 08L

The Skylab EREP S192 Multispectral Scanner data have provided for the first time an opportunity to examine the reflectance characteristics of snowcover in several spectral bands extending from the visible into the near-infrared spectral region. The analysis of the S192 imagery and digital tape data indicates a sharp drop in reflectance of snow in the near-infrared, with snow becoming essentially nonreflective in Bands 11 (1.55-1.75 micron) and 12 (2.10-2.35 micron). Two potential applications to snow mapping of measurements in the near-infrared spectral region are possible: (1) the use of a near-infrared band in conjunction with a visible band to distinguish automatically between snow and water droplet clouds; and (2) the use of one or more near-infrared bands to detect areas of melting snow. Author

**N76-16577\*** Geological Survey, Tacoma, Wash.

### **COMPARISON OF DIFFERENT METHODS FOR ESTIMATING SNOWCOVER IN FORESTED, MOUNTAINOUS BASINS USING LANDSAT (ERTS) IMAGES**

M. J. Meier and W. E. Evans (Stanford Res. Inst., Menlo Park, Calif.) / In NASA. Goddard Space Flight Center Operational Appl. of Satellite Snowcover Observations 1975 p 215-234 refs  
(Paper-16) CSCL 08L

Snow-covered areas on LANDSAT (ERTS) images of the Santiam River basin, Oregon, and other basins in Washington were measured using several operators and methods. Seven methods were used: (1) Snowline tracing followed by measurement with planimeter, (2) mean snowline altitudes determined from many locations, (3) estimates in 2.5 x 2.5 km boxes of snow-covered area with reference to snow-free images, (4) single radiance-threshold level for entire basin, (5) radiance-threshold setting locally edited by reference to altitude contours and other images, (6) two-band color-sensitive extraction locally edited as in (5), and (7) digital (spectral) pattern recognition techniques. The seven methods are compared in regard to speed of measurement, precision, the ability to recognize snow in deep shadow or in trees, relative cost, and whether useful supplemental data are produced. Author

**N76-16578\*** Zurich Univ. (Switzerland). Dept. of Geography. APPROACHES TO DIGITAL SNOW MAPPING WITH LANDSAT-1 DATA

K. I. Itten *In* NASA. Goddard Space Flight Center. Operational Appl. of Satellite Snowcover Observations 1975 p 235-247. refs Sponsored in part by ESA

(Paper-17) CSCL 08L

Applying the same LANDSAT-1 data to three substantially different image processing systems, a snow mapping task was performed. LARSYS Ver.3, STANSORT-2, and General Electric Image-100 did all the jobs of detecting the snowline in forested mountainous terrain, and to determine the snowcovered area. While the control and accuracy achieved with LARSYS is remarkable, time and effort to perform the processing favor the systems STANSORT and Image-100. The experiences and results demonstrate the need for a fast interactive system for operational snowmapping with multispectral satellite data. Author

**N76-16579\*** California Univ., Davis.

## AN ALL DIGITAL APPROACH TO SNOW AREAL MAPPING AND SNOW MODELLING

V. Ralph Algazi and Minsoo Suk *In* NASA. Goddard Space Flight Center Operational Appl. of Satellite Snowcover Observations 1975 p 249-257 refs

(Grant NGL-05-003-404)

(Paper-18) CSCL 08L

Remote sensing data were incorporated into a spatially distributed model of snowpack evolution. Preliminary results are presented on the estimation of primary parameters needed in such a model. Author

**N76-16580\*** Maryland Univ., College Park.

## DIGITAL SNOW MAPPING TECHNIQUE USING LANDSAT DATA AND GENERAL ELECTRIC IMAGE 100 SYSTEM

William C. Dallam (GE Co., Beltsville, Md.) and James L. Foster *In* NASA. Goddard Space Flight Center Operational Appl. of Satellite Snowcover Observations 1975 p 259-278 refs

(Paper-19) CSCL 08L

In this study, a technique and procedures using General Electric IMAGE 100 system were derived for performing a snow cover analysis of small watersheds for quasi-operational application. The study area was the Wind River Mountains of west central Wyoming. A small watershed, namely, Dinwoody Creek was selected as a test site. LANDSAT data and U-2 imagery were used in the analysis. From a minimal snowcover LANDSAT scene, multispectral analysis was performed yielding the distribution of forest, bare rock, grassland, water, and snow within the watershed. The forest and bare rock themes were saved and registered with other scenes containing greater snow cover. Likewise, elevation contours from a digitized map were stored and superimposed over the snowpack areas. Author

**N76-16581\*** Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.

## SNOW COVER MONITORING BY MACHINE PROCESSING OF MULTITEMPORAL LANDSAT MSS DATA

S. G. Luther, L. A. Bartolucci, and R. M. Hoffer *In* NASA. Goddard Space Flight Center Operational Appl. of Satellite Snowcover Observations 1975 p 279-294 refs

(Contract NAS5-21880)

(Paper-20) CSCL 08L

LANDSAT frames were geometrically corrected and data sets from six different dates were overlaid to produce a 24 channel (six dates and four wavelength bands) data tape. Changes in the extent of the snowpack could be accurately and easily determined using a change detection technique on data which had previously been classified by the LARSYS software system. A second phase of the analysis involved determination of the relationship between spatial resolution or data sampling frequency and accuracy of measuring the area of the snowpack. Author

**N76-16582\*** Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.

## SNOWCOVER MAPPING BY MACHINE PROCESSING OF SKYLAB AND LANDSAT MSS DATA

L. A. Bartolucci, R. M. Hoffer, and S. G. Luther *In* NASA. Goddard Space Flight Center Operational Appl. of Satellite Snowcover Observations 1975 p 295-311 refs

(Contract NAS9-13380)

(Paper-21) CSCL 08L

SkyLab and LANDSAT MSS data were analyzed using computer-aided analysis techniques (CAAT). Results indicated that the middle infrared wavelength bands of the SkyLab S-192 scanner would allow effective discrimination between snowcover and water-droplet clouds, whereas the limited spectral response of the LANDSAT-1 or 2 scanners do not allow such spectral discrimination. Five spectral classes of snowcover were defined and mapped. These classes were found to be related to differences in the proportion of snow and forest cover in the individual resolution elements. Author

**N76-16583\*** National Environmental Satellite Service, Washington, D.C.

## ESTIMATING SNOW DEPTH USING VHRR DATA FROM NOAA ENVIRONMENTAL SATELLITES Progress Report

D. F. McGinnis, Jr. *In* NASA. Goddard Space Flight Center Operational Appl. of Satellite Snowcover Observations 1975 p 313-324 refs

(Paper-22) CSCL 08L

The NOAA environmental satellites provide daily coverage of the earth in the visible and thermal spectral bands. The ground resolution of the very high resolution radiometer is 1 km at nadir. This improved resolution in the visible permits more detailed observations of snow features than was possible with previous operational satellites. A densitometer examination of a visible-band image from Feb. 11, 1973, which shows heavy snow cover in considerable detail over areas extending from Alabama to North Carolina, indicates that, in general, there is direct correlation between increasing brightness and increasing snow depths. A power regression analysis of greatest satellite brightness versus greatest snow depth for 201 data pairs produced a correlation coefficient of 0.86. Similar analysis of five late winter and early spring cases resulted in much lower correlations. Author

**N76-16584\*** California Univ., Berkeley.

## A COMPARISON OF OPERATIONAL AND LANDSAT-AIDED SNOW WATER CONTENT ESTIMATION SYSTEMS

James M. Sharp and Randall W. Thomas *In* NASA. Goddard Space Flight Center Operational Appl. of Satellite Snowcover Observations 1975 p 325-344 refs

(Grant NGL-05-003-404)

(Paper-23) CSCL 08L

How LANDSAT imagery can be cost effectively employed to augment an operational hydrologic model is described. Attention is directed toward the estimation of snow water content, a major predictor variable in the volumetric runoff forecasting model. A stratified double sampling scheme is supplemented with qualitative and quantitative analyses of existing operations to develop a comparison between the existing and satellite-aided approaches to snow water content estimation. Results show a decided advantage for the LANDSAT-aided approach. Author

**N76-16587\*** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

## SNOW WETNESS MEASUREMENTS FOR MELT-FORECASTING

William I. Linlor, Fred D. Clapp (California Univ., Berkeley), Mark F. Meier (Geological Survey, Tacoma, Wash.), and James L. Smith (Forest Service, Berkeley, Calif.) *In* its Operational Appl. of Satellite Snowcover Observations 1975 p 375-397 refs

(Paper-26) CSCL 08L

A microwave technique for directly measuring snow pack wetness in remote installations is described. The technique, which uses satellite telemetry for data gathering, is based on the attenuation of a microwave beam in transmission through snow. Author

## 06 HYDROLOGY AND WATER MANAGEMENT

**N76-16590\*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.  
**SUMMARY OF THE OPERATIONAL APPLICATIONS OF SATELLITE SNOWCOVER OBSERVATIONS WORKING SESSION, 20 AUGUST 1975**  
 V. V. Salomonson and A. Rango. In its Operational Appl. of Satellite Snowcover Observations 1975 p 421-426

(Paper-29) CSCL 08L

Various techniques for reducing the satellite data to a form usable by the operational agencies were covered in mini-presentations by the operational satellite snow interpretive personnel. Similar discussions were made by operational agency stream flow forecasters on how satellite-derived snow data could be incorporated into runoff forecasting methods. J.A.M.

**N76-16599\*** Bonneville Power Administration, Portland, Oreg.  
**AN OPERATIONAL APPLICATION OF SATELLITE SNOW COVER OBSERVATIONS, NORTHWEST UNITED STATES Final Report**

John P. Dillard. Nov. 1975 32 p refs

(NASA Order S-53877)

(NASA-CR-144723) Avail: NTIS HC \$4.00 CSCL 08L

LANDSAT-1 imagery showing extent of snow cover was collected and is examined for the 1973 and 1974 snowmelt seasons for three Columbia River Basins. Snowlines were mapped and the aerial snow cover was determined using satellite data. Satellite snow mapping products were compared products from conventional information sources (computer programming and aerial photography was used). Available satellite data were successfully analyzed by radiance thresholding to determine snowlines and the attendant snow-covered area. Basin outline masks, contour elevation masks, and grid overlays were utilized as satellite data interpretation aids. Verification of the LANDSAT-1 data was generally good although there were exceptions. A major problem was lack of adequate cloud-free satellite imagery of high resolution and determining snowlines in forested areas.

Author

**N76-16600\*** Stanford Research Inst., Menlo Park, Calif.  
**MEASURING SNOW COVER USING SATELLITE IMAGERY DURING 1973 AND 1974 MELT SEASON: NORTH SANTIAM, BOISE, AND UPPER SNAKE BASINS, PHASE 1 Final Report**

E. J. Wiegman, W. E. Evans, and R. Hadfield. Jul. 1975 79 p  
 Sponsored in part by Corps of Engineers

(NASA Order S-53442; SRI Proj. 4122)

(NASA-CR-144719) Avail: NTIS HC \$5.00 CSCL 08L

Measurements are examined of snow coverage during the snow-melt season in 1973 and 1974 from LANDSAT imagery for the three Columbia River Subbasins. Satellite derived snow cover inventories for the three test basins were obtained as an alternative to inventories performed with the current operational practice of using small aircraft flights over selected snow fields. The accuracy and precision versus cost for several different interactive image analysis procedures was investigated using a display device, the Electronic Satellite Image Analysis Console. Single-band radiance thresholding was the principal technique employed in the snow detection, although this technique was supplemented by an editing procedure involving reference to hand-generated elevation contours. For each data and view measured, a binary thematic map or 'mask' depicting the snow cover was generated by a combination of objective and subjective procedures. Photographs of data analysis equipment (displays) are shown.

Author

**N76-17446\*** Norwegian Water Resources and Electricity Board, Oslo.

**HYDROLOGICAL INVESTIGATIONS IN NORWAY Quarterly Report, 1 Aug. - 1 Nov. 1975**

Helge A. Odgaard, Principal Investigator 1 Nov. 1975 4 p  
 Sponsored by NASA ERTS

(E76-10137; NASA-CR-146146) Avail: NTIS HC \$3.50 CSCL 08H

**N76-17447\*** Ecole Pratique des Hautes Etudes, Paris (France).  
**THE FRENCH ATLANTIC LITTORAL AND THE MASSIF ARMORICAIN Progress Report, Sep. - Dec. 1975**

Fernand Verger, Principal Investigator and Jean-Marie Monget Dec. 1975 7 p refs Sponsored by NASA and CNES ERTS (E76-10138; NASA-CR-146147; Rept-1) Avail: NTIS HC \$3.50 CSCL 08F

**N76-17451\*** Colorado Univ., Boulder. Inst. of Arctic and Alpine Research.

**APPLICATION OF LANDSAT DATA TO DELIMITATION OF AVALANCHE HAZARDS IN MONTANE, COLORADO Interim Report, Sep. - Dec. 1975**

Daniel H. Knepper, Principal Investigator, J. D. Ives, and R. Summer Jan. 1976 20 p refs ERTS

(Contract NAS5-20914)

(E76-10142; NASA-CR-146151) Avail: NTIS HC \$3.50 CSCL 08F

The author has identified the following significant results. Photointerpretation of individual avalanche paths on single band black and white LANDSAT images is greatly hindered by terrain shadows and the low spatial resolution of the LANDSAT system. Maps produced in this way are biased towards the larger avalanche paths that are under the most favorable illumination conditions during imaging; other large avalanche paths, under less favorable illumination, are often not detectable and the smaller paths, even those defined by sharp trimlines, are only rarely identifiable.

**N76-17460\*** Kansas Univ., Lawrence. Space Technology Center.

**SKYLAB STUDY OF WATER QUALITY Final Report, 23 Feb. - 31 Jul. 1975**

Harold L. Yarger, Principal Investigator and James R. McCauley 31 Jul. 1975 39 p refs EREP

(Contract NAS9-13271)

(E76-10151; NASA-CR-144505) Avail: NTIS HC \$4.00

The author has identified the following significant results. Apparent reflectance levels in the Skylab S190A and S192 bands, from one pass over three Kansas reservoirs, exhibit good statistical correlation with suspended solids. Band ratios appear to yield the best results. The concentration of suspended solids, mostly inorganic sediment, has the most effect on the reflected energy. Dissolved solids concentrations up to 200 ppm were not detectable by the Skylab sensors.

**N76-17467\*** Arizona Univ., Tucson. School of Renewable Natural Resources.

**SOUTHERN ARIZONA RIPARIAN HABITAT: SPATIAL DISTRIBUTION AND ANALYSIS**

John R. Lacey, Phil R. Ogden, and Kenneth E. Foster Aug. 1975 157 p refs Sponsored in part by Natl. Resources Comm., Ariz. State Senate

(Grant NGL-03-002-313)

(NASA-CR-146415; OALS-Bull-8) Avail: NTIS HC \$6.75 CSCL 08F

The objectives of this study were centered around the demonstration of remote sensing as an inventory tool and researching the multiple uses of riparian vegetation. Specific study objectives were to: (1) map riparian vegetation along the Gila River, San Simon Creek, San Pedro River, Pantano Wash, (2) determine the feasibility of automated mapping using LANDSAT-1 computer compatible tapes, (3) locate and summarize existing maps delineating riparian vegetation, (4) summarize data relevant to Southern Arizona's riparian products and uses, (5) document recent riparian vegetation changes along a selected portion of the San Pedro River, (6) summarize historical changes in composition and distribution of riparian vegetation, and (7) summarize sources of available photography pertinent to Southern Arizona.

Author

**N76-17476\*** Purdue Univ., Lafayette, Ind.  
**DELINEATION OF THE BOUNDARIES OF A BURIED PRE-GLACIAL VALLEY WITH LANDSAT-1 DATA**

J. B. Peterson, F. E. Goodrick, and W. N. Melhorn /*In* NASA, Lyndon B. Johnson Space Center. NASA Earth Resources Survey Symp. Vol. 1-A: Agr., Environment Jun. 1975 p 97-103 refs

(A-7) CSCL 08B

The continuity of a narrow meandering strip of Udoll (prairie) soils running east and west for approximately 40 miles across north central Indiana in an area predominantly of Udalfs (timber soils) was detected from LANDSAT-1 data taken on June 9, 1973. This data was processed through a clustering procedure and classified with resulting increased definition of the boundaries among soils grouped according to nine categories and vegetation to two categories of reflectance. This dark stretch of prairie soil is believed to have formed in the heavy textured, poorly drained glacial debris which filled a major pre-glacial tributary of the Teays River System. Ready identification and location of the valley has significance to soil survey and land classification people as a guide to soil classification and land use and to geologists as a guide to location of a potentially economically significant aquifer. Author

**N76-17493\*** Kansas Univ., Lawrence.

**QUANTITATIVE WATER QUALITY WITH LANDSAT AND SKYLAB**

Harold Yarger and James R. McCauley /*In* NASA, Lyndon B. Johnson Space Center. NASA Earth Resources Survey Symp. Vol. 1-A: Agr., Environment Jun. 1975 p 347-370 refs (For

(E-9) CSCL 08H

Correlation studies were completed between LANDSAT Multispectral Scanner (MSS) band ratios derived from computer compatible tape (CCT) and 170 water samples taken from three large Kansas reservoirs, coincident with 16 different LANDSAT passes over a 13 month period. The following conclusions were obtained: (1) LANDSAT MSS reflectance levels are useful for quantitative measurement of suspended solids up to at least 900 ppm. (2) MSS band ratios derived from CCT can measure suspended solids with 67% confidence level accuracy of 12 ppm over the range 0-80 ppm and 35 ppm over the range 0-900 ppm. (3) suspended solids contour maps can be easily constructed from CCT for water bodies larger than approximately 100 acres. (4) rationing suppresses MSS reflectance level dependence on seasonal sun angle variation and permits measurement of suspended load the year round in the middle latitudes. SKYLAB imagery from a single pass over three reservoirs compares favorably to LANDSAT results up to 100 ppm. Author

**N76-17495\*** Environmental Protection Agency, Corvallis, Oreg. Eutrophication Survey Branch.

**THE LANDSAT-1 MULTISPECTRAL SCANNER AS A TOOL IN THE CLASSIFICATION OF INLAND LAKES**

D. H. P. Boland and Richard J. Blackwell (Jet Propulsion Lab., Pasadena, Calif.) /*In* NASA, Lyndon B. Johnson Space Center. NASA Earth Resources Survey Symp. Vol. 1-A: Agr., Environment Jun. 1975 p 419-442 refs

(E-11) CSCL 08H

Relationships between LANDSAT-1 multispectral scanner (MSS) data and the trophic status of a group of lakes in the north-northeastern part of the United States were studied by predicting the magnitudes of two trophic state indicators, estimating lake position on a multivariate trophic scale, and automatically classifying lakes according to their trophic state. Initially, the principal component ordination was employed with 100 lakes. MSS data for some 20 lakes was then extracted from computer-compatible tapes (CCT) using a binary marking technique. The output was in the form of descriptive statistics and photographic concatenations. Color ratios were incorporated into regression models for the prediction of Secchi disc transparency, chlorophyll a, and lake position on the trophic scale. Results indicate that the LANDSAT-1 system, although handicapped by low spectral and spatial resolutions as well as excessive cloud cover, can be used as a supplemental data source in lake survey programs. Author

**N76-17496\*** Wisconsin Univ., Madison. Inst. for Environmental Studies.

**TROPHIC STATUS OF INLAND LAKES FROM LANDSAT**

Lawrence T. Fisher and Frank L. Scarpace /*In* NASA, Lyndon B. Johnson Space Center. NASA Earth Resources Survey Symp. Vol. 1-A: Agr., Environment Jun. 1975 p 443-450 refs

(E-12) CSCL 08H

A first-cut assessment of the trophic status of inland lakes in Wisconsin was obtained from LANDSAT data. To satisfy the criteria of the project, a large and versatile computer program was developed to gain access to LANDSAT data. This analysis technique has proven to be a cost-effective method of classifying inland lakes in Wisconsin. Author

**N76-17499\*** Geological Survey, Tampa, Fla. Water Resources Div.

**AUTOMATIC CATEGORIZATION OF LAND-WATER COVER TYPES OF THE GREEN SWAMP, FLORIDA, USING SKYLAB MULTISPECTRAL SCANNER (S-192) DATA**

A. E. Coker, A. L. Higer (Geol. Survey, Miami, Fla.), R. H. Rogers (Bendix Corp., Ann Arbor, Mich.), N. J. Shah (Bendix Corp., Ann Arbor, Mich.), L. Reed (Bendix Corp., Ann Arbor, Mich.), and S. Walker (Bendix Corp., Ann Arbor, Mich.) /*In* NASA, Lyndon B. Johnson Space Center. NASA Earth Resources Survey Symp. Vol. 1-A: Agr., Environment Jun. 1975 p 479-506 refs

(E-15) CSCL 08H

The techniques used and the results achieved in the successful application of Skylab Multispectral Scanner (EREP S-192) high-density digital tape data for the automatic categorizing and mapping of land-water cover types in the Green Swamp of Florida were summarized. Data was provided from Skylab pass number 10 on 13 June 1973. Significant results achieved included the automatic mapping of a nine-category and a three-category land-water cover map of the Green Swamp. The land-water cover map was used to make interpretations of a hydrologic condition in the Green Swamp. This type of use marks a significant breakthrough in the processing and utilization of EREP S-192 data. Author

**N76-17585\*** National Aeronautics and Space Administration. Earth Resources Labs., Bay St. Louis, Miss.

**REMOTE SENSING OF SALINITY**

Gary C. Thomann /*In* its NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975 p 2099-2126 refs

(M-12) CSCL 08J

The complex dielectric constant of sea water is a function of salinity at 21 cm wavelength, and sea water salinity can be determined by a measurement of emissivity at 21 cm along with a measurement of thermodynamic temperature. Three aircraft and one helicopter experiments using two different 21 cm radiometers were conducted under different salinity and temperature conditions. Single or multiple ground truth measurements were used to calibrate the data in each experiment. It is inferred from these experiments that accuracies of 1 to 2%/00 are possible with a single surface calibration point necessary only every two hours if the following conditions are met--water temperatures above 20 C, salinities above 10%/00, and level plane flight. More frequent calibration, constraint of the aircraft's orientation to the same as it was during calibration, and two point calibration (at a high and low salinity level) rather than single point calibration may give even better accuracies in some instances. Author

**N76-17588\*#** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

**NASA EARTH RESOURCES SURVEY SYMPOSIUM. VOLUME 1-D: WATER RESOURCES First Comprehensive Symposium on the Practical Application of Earth Resources Survey Data**

Jun. 1975 527 p refs Symp. held at Houston, Tex., 9-12 Jun. 1975 See also Vol. 1-A N76-17469; Vol. 1-B N76-17501; Vol.

## 06 HYDROLOGY AND WATER MANAGEMENT

1-C N76-17552; Vol. 3 N76-17613; Original contains color imagery. Original NASA photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198

(NASA-TM-X-58168-Vol-1-D; JSC-09930-Vol-1-D) Avail: NTIS HC \$7.25 CSCL 05B

Conference papers on water resources and management are summarized. Summaries cover land use, flood control and prediction, watersheds and the effects of snow melt, soil moisture content, and the usefulness of satellite remote sensors in detecting ground and surface water.

**N76-17589\*** Wyoming Univ., Laramie. Dept. of Geology.  
**THE USE OF SKYLAB AND LANDSAT IN A GEOHYDROLOGICAL STUDY OF THE PALEOZOIC SECTION, WEST-CENTRAL BIGHORN MOUNTAINS, WYOMING**

Barbara J. Tones *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-D Jun. 1975 p 2167-2182 refs

(W-1) CSCL 08H

Sites of geologic structures were identified using Skylab and LANDSAT imagery, and their relationships to ground water recharge and discharge were studied. The study area lies along the western slope of the Bighorn Mountains. Runoff flowing from the Precambrian core of the Bighorn Mountains sinks as it flows over outcrops of the Bighorn dolomite. A comparison of photo-geologic maps prepared from Skylab and LANDSAT imagery and a geologic map compiled by Darton (1906) illustrates that photomapping, by itself, cannot supply adequate detail but can supplement reconnaissance mapping. Lineation maps were compiled from LANDSAT and Skylab images and compared to similar maps compiled by other investigators. Author

**N76-17590\*** Bundesanstalt fuer Geowissenschaften und Rohstoffe, Hanover (West Germany).

**HYDROGEOLOGICAL INVESTIGATIONS IN THE PAMPA OF ARGENTINA**

Wolfgang Kruck and Wilfried Kantor *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-D Jun. 1975 p 2183-2197 refs

(W-2) CSCL 08H

In large areas of the Argentinian Pampa the salinization of ground water creates water supply difficulties. Investigations of satellite imagery (Landsat-1 and Skylab) which were based on an extensive ground survey revealed that differences in the vegetation cover are closely related to depth and salinity of ground water. Narrow elongated depressions called bajos are often the only indication of fresh ground water. They can be easily detected on the imagery. Due to their high resolution, Skylab photos even allow a quantitative estimation of fresh ground water situated below the bajos. In general however Landsat-1 imagery sufficed for evaluation. In the area of the Rio Tercero a fossil drainage pattern was discovered and in Corrientes province, soil types could be discriminated and compared to the Soil Map of the World. Author

**N76-17595\*** Texas Univ., Austin. Dept. of Geological Sciences.

**FLOOD HAZARD STUDIES IN CENTRAL TEXAS USING ORBITAL AND SUBORBITAL REMOTE SENSING MACHINERY**

Victor R. Baker, Robert K. Holz, and Peter C. Patton *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-D Jun. 1975 p 2253-2294 refs

(Contract NAS9-13312)

(W-8) CSCL 08H

Central Texas is subject to infrequent, unusually intense rainstorms which cause extremely rapid runoff from drainage basins developed on the deeply dissected limestone and marl bedrock of the Edwards Plateau. One approach to flood hazard evaluation in this area is a parametric model relating flood hydrograph characteristics to quantitative geomorphic properties

of the drainage basins. The preliminary model uses multiple regression techniques to predict potential peak flood discharge from basin magnitude, drainage density, and ruggedness number. After mapping small catchment networks from remote sensing imagery, input data for the model are generated by network digitization and analysis by a computer assisted routine of watershed analysis. The study evaluated the network resolution capabilities of the following data formats: (1) large-scale (1:24,000) topographic maps, employing Strahler's 'method of v's,' (2) standard low altitude black and white aerial photography (1:13,000 and 1:20,000 scales), (3) NASA - generated aerial infrared photography at scales ranging from 1:48,000 to 1:123,000, and (4) Skylab Earth Resources Experiment Package S-190A and S-190B sensors (1:750,000 and 1:500,000 respectively). Author

**N76-17596\*** Centro Interamericano de Fotointerpretacion, Bogota (Colombia).

**AN INUNDATION STUDY OF THE LOWER MAGDALENA-CAUCA RIVER BASIN**

Edward Vanes, Hernan Gomez, and Robert Soeters *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-D Jun. 1975 p 2295-2297

(W-9) CSCL 08H

Annual floodings affect about 35,000 sq km of the Lower Magdalena-Cauca River Basin in the northern part of Colombia. Efforts made to determine the effects of inundation extension and complex factors involved in the flooding problem are reported. An integrated survey was made of the entire river basin with the object of land reclamation in the lower part and determining the effects of inundation extension and other complex factors on flooding. Modern remote sensing techniques were for the study. Author

**N76-17597\*** Colorado State Univ., Fort Collins.

**REMOTE SENSING OF MISSISSIPPI RIVER CHARACTERISTICS**

J. F. Ruff, M. M. Skinner (Corps of Engr., Vicksburg, Miss.), B. R. Winkley, D. B. Simons, and D. E. Dorratcague (CH2M Hill) *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-D Jun. 1975 p 2299-2315 refs

(W-10) CSCL 08H

A data collection program initiated by the Vicksburg District, to develop a workable knowledge of the principles relating to the transport of water and sediment to gain a better understanding of the Mississippi River characteristics is introduced. Aerial photographs and thermal infrared imagery were collected over two test reaches at low and high water stages. Qualitative interpretation of the data relates to the river characteristics such as flow patterns, relative velocities, sediment concentration distribution, water-depth effects, and effects of man made structures. Ground truth information is correlated with the remotely sensed data. Author

**N76-17598\*** Wisconsin Univ., Madison.

**APPLICATION OF THERMAL SCANNING TO THE STUDY OF TRANSVERSE MIXING IN RIVERS**

J. Wayland Eheart *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-D Jun. 1975 p 2317-2324 ref

(W-11) CSCL 08H

Remote sensing has shown itself to be a valuable research tool in the study of transverse mixing in rivers. It is desirable, for a number of reasons, to study and predict the two-dimensional movement of pollutants in the region just downstream of a pollutant discharge point. While many of the more common pollutants do not exhibit a spectral signature, it was shown that the temperature difference between the pollutant and the receiving water could be successfully exploited by applying a mathematical model of mass transport processes to heat transport, and testing and calibrating it with thermal scanning data. Author

**N76-17599\*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

**UTILIZATION OF LANDSAT DATA FOR WATER QUALITY SURVEYS IN THE CHOPTANK RIVER**

James M. Johnson (GE, Beltsville, Md.), Philip Cressy, and William C. Dallam (GE, Beltsville, Md.) *In its* NASA Earth Resources Surv. Symp., Vol. 1-D Jun. 1975 p 2325-2350 refs

(W-12) CSCL 08H

Computer processing of LANDSAT-1 multispectral digital data demonstrated the applicability of remotely sensed data to water quality survey in the Choptank River. Water classes derived by automated analysis correlate to river nuisance levels of chlorophyll a and sediment loading as defined by the Maryland Department of Water Resources and the U.S. Corps of Engineers. Results indicate that an increase in chlorophyll a concentration corresponds, relative to MSS 5, to decreases in 4 and increases in 6 relative to the trends with increasing sediment load. It appears that for the purpose of water quality analysis, under favorable atmospheric conditions, only MSS 4, 5 and 6 are necessary. Author

**N76-17600\*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

**HYDROLOGIC LAND USE CLASSIFICATION OF THE PATUXENT RIVER WATERSHED USING REMOTELY SENSED DATA**

William C. Dallam (GE, Beltsville), Albert Rango, and Lurie Shima *In its* NASA Earth Resources Surv. Symp., Vol. 1-D Jun. 1975 p 2351-2364 refs

(W-13) CSCL 08H

The Patuxent River Watershed is located in central Maryland between Baltimore and Washington, D.C. and is approximately 2330 sq km in area and 175 km long. This region is now at a critical point because of major concerns such as water management and quality, flooding and land use within the watershed. Data from the NASA-directed LANDSAT and Earth Resources Aircraft Programs were used to provide a new dimension in information collection and processing for the management of watersheds. Digital data from LANDSAT-1 were analyzed along with selected IR photography from U-2 flight number 74-0608 taken 28 April 1974, which was digitized in three channels. Processing of the data was accomplished using a multispectral analysis system. Land use themes consisting of surface water, wetlands, forest, residential, cropland/pasture, urban, and extractive were developed and delineated through the watershed. Area measurements of watershed themes were obtained and will serve as a calibration input to a deterministic hydrologic model on a sub-watershed. Using the derived residential and urban theme areas from LANDSAT an estimated basin imperviousness was also calculated. Thematic maps were produced at 1:62,500 scale. Floodprone areas were also classified and delineated at a scale of 1:24,000. Comparison with standard floodprone area maps at the same scale have indicated a few areas of discrepancy. Such information can be used for updating or checking floodprone area boundaries as well as monitoring changes in floodplain areas. Author

**N76-17601\*** Maryland Univ., College Park. Dept. of Civil Engineering.

**LAND USE CLASSIFICATION FOR HYDROLOGIC MODELS USING INTERACTIVE MACHINE CLASSIFICATION OF LANDSAT DATA**

Thomas J. Jackson, Robert M. Ragan, and Richard H. McCuen *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-D Jun. 1975 p 2365-2378 refs

(W-14) CSCL 08B

A study was developed to investigate the use of computer aided analysis of LANDSAT multispectral data in estimating percent of imperviousness and associated land uses needed in urban hydrologic modeling. An interactive computer was used to delineate seven land use classifications in the 342 sq. km. Maryland portion of the Anacostia River Basin from LANDSAT data. These results compared favorably with those of an earlier study which obtained the same information through analysis of

aerial photographs having a scale of 1:4800. Approximately 94 man days were required to complete the land use analysis using the aerial photographs while less than three man days were required to accomplish similar tasks using the LANDSAT data. Author

**N76-17602\*** Texas A&M Univ., College Station.

**REMOTE SENSING TECHNIQUES FOR PREDICTION OF WATERSHED RUNOFF**

Bruce J. Blanchard *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-D Jun. 1975 p 2379-2406 refs Sponsored in part by NASA and USDA

(W-15) CSCL 08H

Hydrologic parameters of watersheds for use in mathematical models and as design criteria for flood detention structures are sometimes difficult to quantify using conventional measuring systems. The advent of remote sensing devices developed in the past decade offers the possibility that watershed characteristics such as vegetative cover, soils, soil moisture, etc., may be quantified rapidly and economically. Experiments with visible and near infrared data from the LANDSAT-1 multispectral scanner indicate a simple technique for calibration of runoff equation coefficients is feasible. The technique was tested on 10 watersheds in the Chickasha area and test results show more accurate runoff coefficients were obtained than with conventional methods. The technique worked equally as well using a dry fall scene. The runoff equation coefficients were then predicted for 22 subwatersheds with flood detention structures. Predicted values were again more accurate than coefficients produced by conventional methods. Author

**N76-17603\*** Geological Survey, Tampa, Fla. Water Resources Div.

**WATER-MANAGEMENT MODEL IN FLORIDA FROM LANDSAT-1 DATA**

A. L. Higer, E. H. Cordes, A. E. Coker (Bendix Corp., Ann Arbor, Mich.), and R. H. Rogers *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-D Jun. 1975 p 2407-2442 refs

(W-16) CSCL 08H

A prototype data acquisition and dissemination network and its effectiveness in improving and/or solving hydrologic problems in southern Florida are evaluated. The network utilized LANDSAT MSS imagery and in situ monitoring by LANDSAT-DCS. Results show water level and rain fall measurements were collected and disseminated in less than two hours, a significant improvement over conventional methods which took up to two months. Improved network performance has also aided the development of water budgets and water distribution to the people, fauna, and flora in the area. Imagery from LANDSAT was also found to enhance the utility of ground measurements. Author

**N76-17604\*** Corps of Engineers, Waltham, Mass. New England Div.

**THE USE OF LANDSAT DCS AND IMAGERY IN RESERVOIR MANAGEMENT AND OPERATION**

Saul Cooper, Paul Bock (Conn. Univ., Storrs), Joseph Horowitz, and Dennis Foran (Conn. Univ., Storrs) *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-D Jun. 1975 p 2443-2522 refs

(W-17) CSCL 08H

Experiments by the New England Division (NED), Corps of Engineers with LANDSAT-1 data collection and imaging systems are reported. Data cover the future usefulness of data products received from satellites such as LANDSAT in the day to day operation of NED water resources systems used to control floods. Author

**N76-17605\*** Texas Water Development Board, Austin.

**THE APPLICATION OF REMOTE SENSING TECHNOLOGY TO THE INVENTORY OF PLAYA LAKES IN THE HIGH PLAINS OF TEXAS**

A. Wayne Wyatt, Michael L. Ellis, and Ann E. Bell *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv.



Symp., Vol. 1-D Jun. 1975 p 2523-2530 refs

(W-18) CSCL 08H

The feasibility of using LANDSAT digital data to inventory the playa lakes of the High Plains region of Texas was investigated. The project will use the detection and mapping (DAM) package developed at NASA-Johnson Space Center. The economy of the High Plains region is dependent on ground water for irrigation and the Ogallala aquifer is being depleted faster than it is being recharged. The playa lakes represent a potential source of artificial recharge for the aquifer and an inventory is the first step in that direction. Author

**N76-17608\*** California State Dept. of Water Resources, Sacramento.

## REMOTE SENSING APPLICATIONS IN WATER RESOURCES MANAGEMENT BY THE CALIFORNIA DEPARTMENT OF WATER RESOURCES

Barry Brown /In NASA, Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-D Jun. 1975 p 2531-2560

(W-19) CSCL 08H

The possibility of applying imagery from high altitude aircraft and satellites sensors to water management in California was evaluated. Results from seven applications studies comparing the costs of using high altitude imagery for various purposes to the costs of using conventional data sources, reveal the high altitude imagery to be more cost effective in six cases and equal to conventional data sources in one case. These results also reveal that the imagery provides a level of quality not generally achievable with uncorrected conventional imagery. Although satellite application studies are not yet complete, preliminary results indicate that some definite possibilities exist for employing satellite imagery on an operational basis within the next few years. Author

**N76-17608\*** California Univ., Santa Barbara. Geography Remote Sensing Unit.

## REMOTE SENSING INPUTS TO WATER DEMAND MODELING

John E. Estes, John R. Jensen, Larry R. Tinney, and Michael Rector (Kern County Water Agency) /In NASA, Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-D Jun. 1975 p 2585-2620 refs

(Grant NGL-05-003-404)

(W-22) CSCL 08H

In an attempt to determine the ability of remote sensing techniques to economically generate data required by water demand models, the Geography Remote Sensing Unit, in conjunction with the Kern County Water Agency of California, developed an analysis model. As a result it was determined that agricultural cropland inventories utilizing both high altitude photography and LANDSAT imagery can be conducted cost effectively. In addition, by using average irrigation application rates in conjunction with cropland data, estimates of agricultural water demand can be generated. However, more accurate estimates are possible if crop type, acreage, and crop specific application rates are employed. An analysis of the effect of saline-alkali soils on water demand in the study area is also examined. Finally, reference is made to the detection and delineation of water tables that are perched near the surface by semi-permeable clay layers. Soil salinity prediction, automated crop identification on a by-field basis, and a potential input to the determination of zones of equal benefit taxation are briefly touched upon. Author

**N76-17609\*** California Univ., Berkeley.

## AREAL EXTENT OF SNOW ESTIMATION IN THE NORTH-EASTERN SIERRA NEVADA MOUNTAINS USING LANDSAT-1 IMAGERY

Edwin F. Katibah /In NASA, Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-D Jun. 1975 p 2621-2641 refs

(Grant NGL-05-003-404)

(W-23) CSCL 08F

Quantification of the surface area of snow covering watersheds is believed to be a useful parameter in estimating snow water content for inclusion in water runoff prediction equations. An operational manual interpretation technique which allows fast and accurate estimates to be made of the areal extent of snow parameter using LANDSAT-1 imagery is documented. The analysis procedures, the statistical results, and the associated costs of this research are presented. Author

**N76-17610\*** Environmental Research and Technology, Inc., Concord, Mass.

## SNOW SURVEY FROM SPACE, WITH EMPHASIS ON THE RESULTS OF THE ANALYSIS OF SKYLAB EREP S192 MULTISPECTRAL SCANNER DATA

James C. Barnes and Michael D. Smallwood /In NASA, Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-D Jun. 1975 p 2643-2659 refs

(Contract NAS9-13305)

(W-24) CSCL 08L

The Skylab EREP S192 multispectral scanner data have provided an opportunity to examine the reflectance characteristics of snow cover in several spectral bands extending from the visible into the near infrared spectral region to about 2 microns. The analysis of the S192 imagery and digital tape data from five EREP passes, two from the SL-2 mission and three from the SL-4 mission, indicates a sharp drop in reflectance of snow in the near infrared, with snow becoming essentially nonreflective in Bands 11 (1.55-1.75 microns) and 12 (2.10-2.35 microns). The results are in good agreement with the results of laboratory experiments. Two potential applications to snow mapping of measurements in the near infrared spectral region are possible: (1) the use of a near infrared band in conjunction with a visible band to distinguish automatically between snow and water droplet clouds, and (2) the use of one or more near infrared bands to detect areas of melting snow. Author

**N76-17611\*** National Environmental Satellite Service, Suitland, Md.

## FACTORS AFFECTING SNOW ASSESSMENT FROM LANDSAT DATA

David F. McGinnis, Jr., Michael C. McMillan, and Donald R. Wiesnet /In NASA, Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-D Jun. 1975 p 2661-2668 refs

(W-25) CSCL 08L

Problems associated with using LANDSAT as a snow monitoring satellite are studied. Data cover problems of slope hindrance in thematic mapping of snow and detection of snow in forested areas. It was concluded that if detector saturation threshold is raised and the upper spectral limit of the MSS is extended, snow extent mapping will be improved along with the likelihood of monitoring some aspects of the physical condition of snow pack. E.H.W.

**N76-17612\*** National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

## OPERATIONAL WATER MANAGEMENT APPLICATIONS OF SNOWCOVERED AREA OBSERVATIONS

Albert Rango, Vincent V. Salomonson, and James L. Foster (Md. Univ., College Park) /In NASA, Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-D Jun. 1975 p 2669-2685 refs

(W-26) CSCL 08L

An effort was made to evaluate the utility of satellite snowcover observations for seasonal streamflow prediction. On a representative, large watershed (10 to the 5th power to 10 to the sixth power sq km) it was found, based on six years of data, that meteorological satellite observations of snow cover early in the snowmelt season exhibit a relationship to seasonal runoff having a statistically significant coefficient of determination of 0.92. Analyses of LANDSAT-1 snow-cover observations over the Wind River Mountains of Wyoming reveals that for areas with infrequent cloud cover the extent of snowcover and its change with time can be monitored on watersheds as small as 10 sq km in areal extent. The change in the snow cover with

time as observed from LANDSAT-1 is found to reflect major differences in seasonal runoff from high altitude (mean altitude > 3 km) and low altitude (< 3 km) watersheds. There are quantitative indications that LANDSAT observations over small watersheds could be used in a manner similar to that employed for meteorological satellite observations to relate the percent of a basin snowcovered on a given date to seasonal runoff. Author

**N76-17621\*** Colorado State Univ., Fort Collins.

#### WATER RESOURCES

D. B. Simons / In NASA. Lyndon B. Johnson Space Center. NASA Earth Resources Surv. Symp., Vol. 3 Jun. 1975 p 41-46

CSCL 08H

Applications of remote sensing technology to analysis of watersheds, snow cover, snowmelt, water runoff, soil moisture, land use, playa lakes, flooding, and water quality are summarized. Recommendations are given for further utilization of this technology. D.M.L.

**N76-17623#** World Meteorological Organization, Geneva (Switzerland).

#### GUIDE TO HYDROLOGICAL PRACTICES

1974 402 p refs

(WMO-168) Avail: NTIS HC \$11.00; WMO, Geneva Sw. Fr. 55

The aim of the guide is to provide information about hydrological practices, procedures and instrumentation. Following a general chapter, sections cover instruments and methods of observation; design of networks; collection, processing and publication of data; hydrological analysis; and hydrological forecasting. Applications of hydrological methods to water management is covered by an appendix. Extensive bibliographies follow each section.

N76-17629.

**N76-17625** World Meteorological Organization, Geneva (Switzerland).

#### DESIGN OF NETWORKS

In its Guide to Hydrol. Pract. 1974 22 p refs

The general requirements of and general principles for the design of hydrological and climatological networks are reviewed. The development of a minimum network is discussed together with the data to be considered in determining the network density. Such data include precipitation and snow cover, water temperature, evaporation and soil moisture. The factors affecting the density of observation stations for a minimum network are noted and the minimum density limit of climatological and hydrometric networks is discussed. The integration of bench-mark stations and representative basins in the network are also considered. ESA

**N76-17627** World Meteorological Organization, Geneva (Switzerland).

#### HYDROLOGICAL ANALYSIS

In its Guide to Hydrol. Pract. 1974 110 p refs

Methods of analysis covering the procedures required for most hydrological purposes are presented. The interpretation of precipitation data, with emphasis on storm rainfall studies, rainfall frequency and intensity and snowmelt, and streamflow data, noting temporal distribution of runoff volume, streamflow routing and flood frequencies, for the purposes of analysis are discussed. The determination of evaporation by various methods is described together with estimates of basin evapotranspiration. The runoff relation between rainfall and snowfall are also considered. A bibliography is appended. ESA

**N76-17628** World Meteorological Organization, Geneva (Switzerland).

#### HYDROLOGICAL FORECASTING

In its Guide to Hydrol. Pract. 1974 63 p refs

The importance of hydrological forecasting is stressed and an idea of the types of hydrological forecasts such as flood predictions, water runoff and snow melt are given. The principal basic methods used to forecast the most important elements of the hydrological regime are described and the applicability of these methods under different climatic conditions is discussed. The forms of hydrological forecasts and their verification are also summarized. ESA

**N76-17629** World Meteorological Organization, Geneva (Switzerland).

#### APPLICATIONS TO WATER MANAGEMENT

In its Guide to Hydrol. Pract. 1974 41 p refs

The application of hydrological analysis methods to the design of water management projects is discussed. An estimation of available surface water supplies is made followed by estimation of design floods. The methods of estimating are described and summarized. The design of flood control works and urban and small catchment drainage works are discussed. An estimation of maximum reservoir levels is also given. ESA

**N76-17639#** Environmental Research Inst. of Michigan, Ann Arbor.

#### INLAND LAKES WATER QUALITY AND WATERSHED PLANNING: REMOTE SENSING TECHNOLOGY APPLICATIONS Final Report, May 1971 - Jun. 1974

T. Borton, C. T. Wezernak, and R. K. Raney Jun. 1975 189 p refs

(Grant NSF GI-34809)

(PB-245620/O; ERIM-193500-6-F1; NSF/RA/E-75/036) Avail: NTIS HC \$7.50 CSCL 13B

This is the final report of a task force exploring the impact of remote sensing and other information systems on public planning and policy decisions related to land development within the drainage basin of a small inland lake. The issue is one of maintaining water quality in the face of pressure to increase the cultural use of the watershed. The approach of the task force was three-fold: (1) to gather, interpret, and provide information regarding the issue to local decision makers; (2) to assist in motivating a common problem recognition among the local people; and (3) to withdraw from the local area, leaving behind sufficient technical resources to meet the needs of local initiatives to action, and to observe early phases of changed environmental decision making. GRA

**N76-18586\*** Corps of Engineers, Waltham, Mass.

#### THE USE OF LANDSAT DCS AND IMAGERY IN RESERVOIR MANAGEMENT AND OPERATION Progress Report

Saul Cooper, Principal Investigator [1975] 7 p refs ERTS (E76-10165; NASA-CR-146366; PR-3) Avail: NTIS HC \$3.50 CSCL 08H

The author has identified the following significant results. The demonstration, local user terminal, has proven the hypothesis that a relatively inexpensive, automatic, and easily maintained ground receiving station for satellite relayed data is practical for an operational use.

**N76-18613\*** Environmental Research Inst. of Michigan, Ann Arbor. Infrared and Optics Div.

#### ANALYSIS OF HYDROLOGICAL FEATURES OF PORTIONS OF THE LAKE ONTARIO BASIN USING SKYLAB AND AIRCRAFT DATA Final Report, Mar. 1973 - Dec. 1975

Fabian C. Polcyn, Principal Investigator, Diana L. Rebel, and John E. Colwell Jan. 1976 100 p refs Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 EREP

(Contract NAS9-13275)

## 06 HYDROLOGY AND WATER MANAGEMENT

(E76-10192; NASA-CR-147456; ERIM-102300-19-F) Avail: NTIS HC \$5.00 CSCL 08H

The author has identified the following significant results. S190A and S190B photography proved to be useful for mapping large scale geomorphological features, and for assessing water depth and water quality. Available S192 data were affected by low frequency noise caused by diode light. Hydrological features were classified, and upland green herbaceous vegetation was separated into several classes based on percent vegetation cover. A model for estimating surface soil moisture based on red and near infrared reflectance data was developed and subsequently implemented.

**N76-18617\*#** Colorado School of Mines, Golden. , Dept. of Geology.

### EVALUATION OF SKYLAB PHOTOGRAPHY FOR WATER RESOURCES, SAN LUIS VALLEY, COLORADO

Keenan Lee, Principal Investigator and David Huntley Dec. 1975 43 p refs EREP

(Contract NAS9-13394)

(E76-10198; NASA-CR-146289; Rept-75-5) Avail: NTIS HC \$4.00 CSCL 08H

The author has identified the following significant results. Skylab S190A photography used in a stereo mode is sufficient for defining the drainage divides and drainage patterns at the regional level. This data, combined with geologic information, define the boundaries and distribution of ground water recharge and discharge areas within the basin.

**N76-18625\*#** National Academy of Sciences - National Research Council, Washington, D.C.

### INLAND WATER RESOURCES Practical Applications of Space Systems

1975 87 p refs  
(Contract NSR-09-012-106)

(NASA-CR-146406; Paper-5) Avail: NTIS HC \$5.00; Space Applications Board, National Research Council, 2101 Constitution Avenue, N. W., Washington, D. C. 20418 CSCL 08H

The work is reported of the panel concerning the application of space technology to the improved management of the nation's inland resources. The progress since the 1967-68 study is briefly reviewed. The data needed for the management of inlet water ways, and the potential benefits of better management are discussed along with 16 proposed demonstration projects.

F.O.S.

**N76-18628\*#** Southern Illinois Univ., Carbondale.  
**THE HYDROLOGY OF PREHISTORIC FARMING SYSTEMS IN A CENTRAL ARIZONA ECOTONE Final Report, period ending 30 Sep. 1975**

George J. Gumerman, John A. Hanson, Douglas Brew, Karl Tomoff, and Carol S. Weed Oct. 1975 270 p refs Original contains color illustrations

(Contract NAS9-14610)

(NASA-CR-144492) Avail: NTIS HC \$9.00 CSCL 08H

The prehistoric land use and water management in the semi-arid Southwest was examined. Remote sensing data, geology, hydrology and biology are discussed along with an evaluation of remote sensing contributions, recommendations for applications, and proposed future remote sensing studies. F.O.S.

**N76-18630\*#** Alabama Univ., University. Bureau of Engineering Research.

### WATER RESOURCES PLANNING FOR RIVERS DRAINING INTO MOBILE BAY Interim Report

Samuel Ng and Gary C. April Jan. 1976 102 p refs

(Contract NAS8-29100)

(NASA-CR-144192; BER-203-112) Avail: NTIS HC \$5.50 CSCL 08H

A hydrodynamic model describing water movement and tidal elevation is formulated, computed, and used to provide basic data about water quality in natural systems. The hydrodynamic

model is based on two-dimensional, unsteady flow equations. The water mass is considered to be reasonably mixed such that integration (averaging) in the depth direction is a valid restriction. Convective acceleration, the Coriolis force, wind and bottom interactions are included as contributing terms in the momentum equations. The solution of the equations is applied to Mobile Bay, and used to investigate the influence that river discharge rate, wind direction and speed, and tidal condition have on water circulation and holdup within the bay. Storm surge conditions, oil spill transport, artificial island construction, dredging, and areas subject to flooding are other topics which could be investigated using the mathematical modeling approach. Author

**N76-18631\*#** Arizona Univ., Tucson.

### AN ASSESSMENT OF THE IMPACT OF WATER IMPOUNDMENT AND DIVERSION STRUCTURES ON VEGETATION IN SOUTHERN ARIZONA

Jeffery S. Conn, David A. Mount, and Robin B. Clark Dec. 1975 93 p refs

(Grant NGL-03-002-313)

(NASA-CR-146325; OALS-Bull-11) Avail: NTIS HC \$5.00 CSCL 08H

High-altitude color infrared photography was used to survey existing conditions, both upstream and downstream, from nineteen diversion structures in Southern Arizona to determine their effect upon vegetation health, vigor, and cover. A diversion structure is defined as a man/made feature constructed to control storm runoff. The results are used to determine the policy for future structure design. Author

**N76-18632\*#** Ecosystems International, Inc., Gambrills, Md.  
**THE APPLICATION OF REMOTE SENSING TO THE DEVELOPMENT AND FORMULATION OF HYDROLOGIC PLANNING MODELS**

Peter A. Castruccio, Harry L. Loats, Jr., and Thomas R. Fowler Jan. 1976 27 p

(Contract NAS8-30539)

(NASA-CR-144203; ECO-76-C-2-2) Avail: NTIS HC \$4.00 CSCL 08H

A hydrologic planning model is developed based on remotely sensed inputs. Data from LANDSAT 1 are used to supply the model's quantitative parameters and coefficients. The use of LANDSAT data as information input to all categories of hydrologic models requiring quantitative surface parameters for their effects functioning is also investigated. Author

**N76-18633\*#** Ecosystems International, Inc., Gambrills, Md.  
**THE APPLICATION OF REMOTE SENSING TO THE DEVELOPMENT AND FORMULATION OF HYDROLOGIC PLANNING MODELS Final Report**

Peter A. Castruccio, Harry L. Loats, Jr., and Thomas R. Fowler 11 Jan. 1976 182 p refs

(Contract NAS8-30539)

(NASA-CR-144204; ECO-76-C-2-1) Avail: NTIS HC \$7.50 CSCL 08H

For abstract, see N76-18632.

**N76-18771\*#** Virginia Inst. of Marine Science, Gloucester Point. Div. of Biological Oceanography.

### REMOTE SENSING OF SUBMERGED AQUATIC VEGETATION IN THE LOWER CHESAPEAKE BAY Final Report

Robert J. Orth and Hayden Gordon Apr. 1975 70 p refs

(Contract NAS1-10720)

(NASA-CR-144918) Avail: NTIS HC \$4.50 CSCL 08A

An experimental water penetration film and black and white near infrared film were used to study the distribution of submerged aquatic vegetation in the lower Chesapeake Bay. Detailed description of the grass beds was obtained by flying at an altitude of 5,000 feet, at low tide when wind conditions were minimal. Results show that there was a 36% reduction in the amount of submerged aquatic vegetation in the lower Chesapeake Bay from 1971 to 1974, the greatest losses occurring in the York, Piankatank and Rappahannock rivers (tabulated data is given). Recovery of some grass beds occurs primarily through seedling recruitment and subsequent vegetative growth. Cownose rays

are suspected as a main factor for the decimation of some of the grass beds. Maps and photographs of the areas studied are given. Author

**N76-19508\*** Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.

**A STUDY OF THE UTILIZATION OF EREP DATA FROM THE WABASH RIVER BASIN Final Report, 1 Apr. 1973 - 8 Dec. 1975**

L. F. Silva, Principal Investigator 1976 145 p refs Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 EREP (Contract NAS9-13301) (E76-10200; NASA-CR-147412) Avail: NTIS HC \$6.00 CSCL 08H

The author has identified the following significant results. The study of the multispectral data sets indicate that better land use delineation using machine processing techniques can be obtained with data from multispectral scanners than digitized S190A photographic sensor data. Results of the multiemulsion photographic data set were a little better than the multiband photographic data set. Comparison results of the interim and filtered S191 data indicate that the data were improved some for machine processing techniques. Results of the S191 X-5 detector array studied over a wintertime scene indicate that a good quality far infrared channel can be useful. The S191 spectroradiometer study results indicate that the data from the S191 was usable, and it was possible to estimate the path radiance.

**N76-19521\*** Corps of Engineers, Waltham, Mass. **THE USE OF LANDSAT DCS AND IMAGERY IN RESERVOIR MANAGEMENT AND OPERATION Progress Report**

Saul Cooper, Principal Investigator 1 Dec. 1975 7 p Sponsored by NASA ERTS (E76-10218; NASA-CR-146320; PR-3) Avail: NTIS HC \$3.50 CSCL 08H

The author has identified the following significant results. The local user terminal has proven, the hypothesis that a relatively inexpensive, automatic, and easily maintained ground receive station for satellite relayed data is practical for operational use. Data acquisition activities were expanded to include both the teletype-relayed information as well as that received directly from local user terminals.

**N76-19526\*** Delaware Univ., Newark. Coll. of Marine Studies.

**THE INFLUENCE OF COASTAL FRONTS ON THE MOVEMENT AND DISPERSION OF OIL SLICKS**

V. Klemas, Principal Investigator, G. Davis, and S. Kupferman 16 Jan. 1976 2 p ERTS (Contract NAS5-20983) (E76-10223; NASA-CR-146334) Avail: NTIS HC \$3.50 CSCL 13B

The author has identified the following significant results. LANDSAT, aircraft, and boats were used successfully to study estuarine and coastal fronts or boundaries. Horizontal salinity gradients of 4‰ in one meter and convergence velocities of the order of 0.1 m/sec were observed. Visibility improved from one meter to two meters as certain boundaries were crossed. Fronts near the mouth of the bay are associated with the tidal exchange with shelf water. By capturing and holding oil slicks, these frontal systems also significantly influence the movement and dispersion of oil slicks in Delaware Bay. Recent oil slick tracking experiments conducted to verify a predictive oil dispersion and movement model have shown that during certain parts of the tidal cycle the oil slicks tend to line up along boundaries.

**N76-19548\*** National Oceanic and Atmospheric Administration, Rockville, Md. **INTERNATIONAL FIELD YEAR FOR THE GREAT LAKES. IFYGL BULLETIN NO. 15**

Aug. 1975 103 p refs

(COM-75-11462/9; IFYGL-Bull-15; NOAA-75092304) Avail: NTIS HC \$5.50 CSCL 08H

Data are presented for both the United States and Canada. The contents include: IFYGL bibliography which contains official IFYGL publications, a bibliography, and additions to the IFYGL bibliography; Canadian project reports; Canadian IFYGL data management report - which contains a list of IFYGL data publications, and abstracts of IFYGL papers; comments by the U.S. director; lake-averaged temperatures and currents in Lake Ontario in 1972; Lake Ontario beginning-of-month levels and changes in storage; U.S. scientific program - which includes tasks, and panel reports; and data management-IFYGL archive.

GRA

**N76-19712** Wisconsin Univ., Madison. Dept. of Meteorology. **GLACIER RECESSON IN EAST AFRICA**

Stefan Hastenrath In WMO Long-term Climatic Fluctuations 1975 p 135-142 refs Copyright.

**N76-19765\*** Virginia Inst. of Marine Science, Gloucester Point. **WATER COLOR AND CIRCULATION SOUTHERN CHESAPEAKE BAY, PART 1**

M. M. Nichols and Hayden H. Gordon Oct. 1975 133 p refs (Contract NAS6-2327) (NASA-CR-141404) Avail: NTIS HC \$6.00 CSCL 08J

Satellite imagery from two EREP passes over the Rappahannock Estuary of the Chesapeake region is analyzed to chart colored water types, to delineate color boundaries and define circulatory patterns. Surface observations from boats and helicopters concurrent with Skylab overpass define the distributions of suspended sediment, transparency, temperature, salinity, phytoplankton, color of suspended material and optical ratio. Important features recorded by the imagery are a large-scale turbidity maximum and massive red tide blooms. Water movement is revealed by small-scale mixing patterns and tidal plumes of apparent sediment-laden water. The color patterns broadly reflect the bottom topography and the seaward gradient of suspended material between the river and the bay. Analyses of red, green and natural color photos by microdensitometry demonstrate the utility of charting water color types of potential use for managing estuarine water quality. The Skylab imagery is superior to aerial photography and surface observations for charting water color.

Author

**N76-20580\*** Geological Survey, Reston, Va. **IMPROVING ESTIMATES OF STREAMFLOW CHARACTERISTICS USING LANDSAT-1 (ERTS-1) IMAGERY Final Report, 1 Jul. 1972 - 30 Jun. 1975**

Esté F. Hollyday, Principal Investigator 31 Aug. 1975 64 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS (NASA Order S-70243-AG) (E76-10230; NASA-CR-146513) Avail: NTIS HC \$4.50 CSCL 08H

The author has identified the following significant results. Streamflow characteristics in the Delmarva Peninsula derived from the records of daily discharge of 20 gaged basins are representative of the full range in flow conditions and include all of those commonly used for design or planning purposes. They include annual flood peaks with recurrence intervals of 2, 5, 10, 25, and 50 years, mean annual discharge, standard deviation of the mean annual discharge, mean monthly discharges, standard deviation of the mean monthly discharges, low-flow characteristics, flood volume characteristics, and the discharge equalled or exceeded 50 percent of the time. Streamflow and basin characteristics were related by a technique of multiple regression using a digital computer. A control group of equations was computed using basin characteristics derived from maps and climatological records. An experimental group of equations was computed using basin characteristics derived from LANDSAT imagery as well as from maps and climatological records. Based on a reduction in standard error of estimate equal to or

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greater than 10 percent, the equations for 12 stream flow characteristics were substantially improved by adding to the analyses basin characteristics derived from LANDSAT imagery.

**N76-20585\*#** National Oceanic and Atmospheric Administration, Washington, D.C.

### **EVALUATION OF LANDSAT-2 DATA FOR SELECTED HYDROLOGIC APPLICATIONS Progress Report**

Donald R. Wiesnet, David F. McGinnis, Jr., Principal Investigators, and Michael C. McMillan 12 Mar. 1976 6 p Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS

(Contract NAS5-3991A)

(E76-10237; NASA-CR-146520) Avail: NTIS HC \$3.50 CSCL 08H

**N76-20605\*#** College for Civil Engineering, Bucharest (Romania), Lab. for Remote Sensing.

### **USE OF LANDSAT DATA FOR RESOURCES INVESTIGATION IN THE LOWER BASIN OF DANUBE AND DANUBE DELTA Progress Report, May - Dec. 1975**

Nicolaie Opreescu, Principal Investigator Dec. 1975 13 p Sponsored by NASA ERTS

(E76-10259; NASA-CR-146631; DaDelta-1/1) Avail: NTIS HC \$3.50 CSCL 08H

The author has identified the following significant results. A most important is that bands 4 and 5 very clearly show the sedimentary discharge into the sea and the spreading regime in the sea at the mouth of the Danube and out at sea at great distances to over 100 km. Another particularly significant result is shown by bands 6 and 7, presenting the successive stages of sediments in the Danube Delta, with the clear marking of the separation between the fluvial and marine delta. The survey of floods and of some of their effects may also be studied on all of the bands in the complex area of the Danube Delta and in the lower basin of the Danube.

**N76-20610\*#** South Dakota State Univ., Brookings. Remote Sensing Inst.

### **INVESTIGATION OF REMOTE SENSING TO DETECT NEAR-SURFACE GROUNDWATER ON IRRIGATED LANDS**

Dennis W. Ryland, Fred A. Schmer, and Donald G. Moore Oct. 1975 48 p Sponsored by NASA

(Contract DI-14-06-700-7466)

(NASA-CR-146550; SDSU-RSI-75-10) Avail: NTIS HC \$4.00 CSCL 08H

The application of remote sensing techniques was studied for detecting areas with high water tables in irrigated agricultural lands. Aerial data were collected by the LANDSAT-1 satellite and aircraft over the Kansas/Bostwick Irrigation District in Republic and Jewell Counties, Kansas. LANDSAT-1 data for May 12 and August 10, 1973, and aircraft flights (midday and predawn) on August 10 and 11, 1973, and June 25 and 26, 1974, were obtained. Surface and water table contour maps and active observation well hydrographs were obtained from the Bureau of Reclamation for use in the analysis. Results of the study reveal that LANDSAT-1 data (May MSS band 6 and August MSS band 7) correlate significantly (0.01 level) with water table depth for 144 active observation wells located throughout the Kansas/Bostwick Irrigation District. However, a map of water table depths of less than 1.83 meters prepared from the LANDSAT-1 data did not compare favorably with a map of seeped lands of less than 1.22 m (4 feet) to the water table. Field evaluation of the map is necessary for a complete analysis. Analysis of three fields on a within or single-field basis for the 1973 LANDSAT-1 data also showed significant correlation results. Author

**N76-20614\*#** National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

### **MEASUREMENT OF LAKE ICE THICKNESS WITH A SHORT-PULSE RADAR SYSTEM**

Dale W. Cooper, Robert A. Mueller, and Ronald J. Schertler Washington Mar. 1976 25 p refs

(NASA-TN-D-8189; E-8573) Avail: NTIS HC \$3.50 CSCL 08L

Measurements of lake ice thickness were made during March 1975 at the Straits of Mackinac by using a short-pulse radar system aboard an all-terrain vehicle. These measurements were compared with ice thicknesses determined with an auger. Over 25 sites were explored which had ice thicknesses in the range 29 to 60 cm. The maximum difference between radar and auger measurements was less than 9.8 percent. The magnitude of the error was less than + or - 3.5 cm. The NASA operating short-pulse radar system used in monitoring lake ice thickness from an aircraft is also described. Author

**N76-20621#** Montana State Univ., Bozeman. Water Resources Research Center.

### **APPLICATION OF MICROWAVE WATER SENSING TECHNIQUES TO WATERSHEDS**

Bruce R. McLeod Jul. 1975 40 p refs

(PB-246196/0; MUJWRR-67; W76-00675;

OWRT-A-079-MONT(1)) Avail: NTIS HC \$4.00 CSCL 08H

The feasibility of applying microwave moisture sensing techniques to the area of watershed management is discussed. A portable, field-usable microwave moisture meter was developed to give rapid, accurate moisture information on such forest fuels as litter, duff, and dead sticks. The project also produced a second type of meter using the same principle of microwave moisture sensing. This instrument monitors, on a real time basis, changes in forest fuel moisture content in response to changes in external stimuli such as humidity changes. Preliminary results show very rapid changes in moisture content for litter. GRA

**N76-21627\*#** Bureau of Mineral Resources, Geology and Geophysics, Canberra (Australia).

### **WATER UTILISATION, EVAPOTRANSPIRATION AND SOIL MOISTURE MONITORING IN THE SOUTHEAST REGION OF SOUTH AUSTRALIA Quarterly Progress Report**

K. John Shepherd, Principal Investigator, Keith R. McCloy, James C. Killick, and Max R. Till [1975] 4 p Sponsored by NASA ERTS

(E76-10234; NASA-CR-146517) Avail: NTIS HC \$3.50 CSCL 08M

**N76-21630\*#** Colorado Univ., Boulder. Inst. of Arctic and Alpine Research.

### **APPLICATION OF LANDSAT DATA TO DELIMITATION OF AVALANCHE HAZARDS IN MONTANE, COLORADO Interim Report, Dec. 1975 - Feb. 1976**

Daniel H. Knepper, Principal Investigator and R. Summier Mar. 1976 16 p refs ERTS

(Contract NAS5-20914)

(E76-10257; NASA-CR-146629; QPR-3) Avail: NTIS HC \$3.50 CSCL 08L

The author has identified the following significant results. With rare exceptions, avalanche areas cannot be identified on LANDSAT imagery. Avalanche hazard mapping on a regional scale is best conducted using LANDSAT imagery in conjunction with complementary data sources. Level of detail of such maps will be limited by the amount and completeness of the complementary information used.

**N76-21636\*#** Bendix Corp., Ann Arbor, Mich. Aerospace Systems Div.

### **APPLICATION OF LANDSAT TO THE SURVEILLANCE AND CONTROL OF LAKE EUTROPHICATION IN THE GREAT LAKES BASIN Progress Report, Jan. - Apr. 1976**

Robert H. Rogers, Principal Investigator Apr. 1976 21 p ERTS

(Contract NAS5-20942)

(E76-10269; NASA-CR-146568; BSR-4224) Avail: NTIS HC \$3.50 CSCL 08H

The author has identified the following significant results. Computer techniques were developed for mapping water quality parameters from LANDSAT data, using surface samples collected in an ongoing survey of water quality in Saginaw Bay. Chemical and biological parameters were measured on 31 July 1975 at 16 bay stations in concert with the LANDSAT overflight. Application of stepwise linear regression bands to nine of these parameters and corresponding LANDSAT measurements for bands 4 and 5 only resulted in regression correlation coefficients that varied from 0.94 for temperature to 0.73 for Secchi depth. Regression equations expressed with the pair of bands 4 and 5, rather than the ratio band 4/band 5, provided higher correlation coefficients for all the water quality parameters studied (temperature, Secchi depth, chloride, conductivity, total kjeldahl nitrogen, total phosphorus, chlorophyll a, total solids, and suspended solids).

**N76-21637\*** Northern Prairie Wildlife Research Center, Jamestown, N. Dak.

**APPLICATION OF LANDSAT SYSTEM FOR IMPROVING METHODOLOGY FOR INVENTORY AND CLASSIFICATION OF WETLANDS** Progress Report, 1 Jan. - 31 Mar. 1976 David S. Gilmer, Principal Investigator and Edgar A. Work, Jr. 5 Apr. 1976 8 p ERTS (NASA Order S-54049-A) (E76-10270; NASA-CR-146569) Avail: NTIS HC \$3.50 CSCL 08B

**N76-21651\*** Geological Survey, Reston, Va.

**[THE USE OF THE LANDSAT DATA COLLECTION SYSTEMS (DCS) FOR RELAYING HYDROLOGIC DATA]** Progress Report

R. W. Paulson, Principal Investigator 31 Mar. 1976 7 p Sponsored by NASA ERTS (E76-10284; NASA-CR-146654) Avail: NTIS HC \$3.50 CSCL 08H

**N76-21655\*** California State Dept. of Water Resources, Sacramento.

**[WATER QUALITY CONDITIONS IN THE SUISUN BAY PORTION OF THE SAN FRANCISCO BAY DELTA SYSTEM]** Progress Report

Randall L. Brown, Principal Investigator 14 Apr. 1976 2 p ERTS (Contract NAS5-20945) (E76-10288; NASA-CR-146656; PR-3) Avail: NTIS HC \$3.50 CSCL 08B

**N76-21664\*** Centre National d'Etudes Spatiales, Paris (France). **THE FRENCH ATLANTIC LITTORAL AND THE MASSIF ARMORICAIN** Progress Report, Jan. - Mar. 1976

Fernand Verger, Principal Investigator, Jean-Marie Monget, and Jean-Yves Scanvic Mar. 1976 28 p refs Sponsored by NASA Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS (E76-10298; NASA-CR-146788; PR-2) Avail: NTIS HC \$4.00 CSCL 08J

The author has identified the following significant results. Diachronic use of LANDSAT data time series will in time allow statistical study of submersion frequencies in tidal areas. This is an essential element of coastal geomorphology and of coastal zone management being particularly useful in siting shellfish farms. Maps are being obtained at useable scales and simple, user oriented legends which can be used for coastal planning.

**N76-21668\*** Texas Univ., Austin. Center for Cybernetic Studies.

**SIMULTANEOUS INVESTMENT-ALLOCATION AND APPLICATION OF GENERALIZED BENDERS DECOMPOSITION TO WATER PLANNING**

Ronald D. Armstrong and Cleve E. Willis (Mass. Univ., Amherst) Aug. 1975 25 p refs

**N76-21673#** National Oceanic and Atmospheric Administration, Ann Arbor, Mich. Environmental Research Lab.

**EVAPORATION FROM LAKE ERIE**

Jan A. Derecki Jun. 1975 92 p

(PB-248300/6; GLERL-3; GLERL-Contrib-28;

NOAA-75121004; NOAA-TR-ERL-342) Avail: NTIS HC \$5.00 CSCL 08H

The monthly evaporation from Lake Erie was derived by the water budget, two mass transfer, energy budget, and two combined mass transfer-energy budget equations. Evaporation determined by a single method is not sufficiently reliable and requires verification of accuracy by different methods. Only the water budget method determines evaporation directly, as a residual from other measurements, and it was used as a control for other estimates of evaporation. The overall analysis of results indicates that reasonably accurate evaporation estimates during the year can be obtained by the water budget and the modified Lake Hefner mass transfer equations, and during the high evaporation season by the energy budget equation. GRA

**N76-21854#** National Environmental Satellite Service, Washington, D.C.

**MONTHLY WINTER SNOWLINE VARIATION IN THE NORTHERN HEMISPHERE FROM SATELLITE RECORDS, 1966-75**

Donald R. Wiesnet and Michael Matson Nov. 1975 27 p refs

(PB-248437/6; NOAA-TM-NESS-74; NOAA-75120904) Avail: NTIS HC \$4.00 CSCL 04B

The application of satellite imagery for detecting, measuring, and mapping mean monthly winter snow cover over the Northern Hemisphere is demonstrated. Maps and graphs are used to depict snow cover for North America, Eurasia, and Northern Hemisphere for the months of December through March for the period 1966-75. Although snow cover over North America tended to be fairly uniform during the 9-year period, over Eurasia and the Northern Hemisphere a cyclical pattern is evident. The NOAA satellites provide a reliable means of monitoring worldwide snow cover, which has important effects on global temperature and albedo. GRA

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## DATA PROCESSING AND DISTRIBUTION SYSTEMS

Includes film processing, computer technology, satellite and aircraft hardware, and imagery.

**A76-18910 \*** **Computer-aided analysis of Landsat-1 MSS data - A comparison of three approaches, including a 'modified clustering' approach.** M. D. Fleming, J. S. Berkebille, and R. M. Hoffer (Purdue University, West Lafayette, Ind.). In: Symposium on Machine Processing of Remotely Sensed Data, 2nd, West Lafayette, Ind., June 3-5, 1975, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 1B-54 to 1B-61. Contracts No. NAS9-14016; No. NAS5-21880; No. NAS9-13380.

Three approaches for analyzing Landsat-1 data from Ludwig Mountain in the San Juan Mountain range in Colorado are considered. In the 'supervised' approach the analyst selects areas of known spectral cover types and specifies these to the computer as training fields. Statistics are obtained for each cover type category and the data are classified. Such classifications are called 'supervised' because the analyst has defined specific areas of known cover types. The second approach uses a clustering algorithm which divides the entire training area into a number of spectrally distinct classes. Because the analyst need not define particular portions of the data for use but has only to specify the number of spectral classes into which the data is to be divided, this classification is called 'nonsupervised'. A hybrid method which selects training areas of known cover type but then uses the clustering algorithm to refine the data into a number of unimodal spectral classes is called the 'modified-supervised' approach. B.J.

**A76-18911 \*** **Single-class classification.** T. C. Minter (Lockheed Electronics Co., Inc., Aerospace Systems Div., Houston, Tex.). In: Symposium on Machine Processing of Remotely Sensed Data, 2nd, West Lafayette, Ind., June 3-5, 1975, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 2A-12 to 2A-15. Contract No. NAS9-12200.

Often, when classifying multispectral data, only one class or crop is of interest, such as wheat in the Large Area Crop Inventory Experiment (LACIE). Usual procedures for designing a Bayes classifier require that labeled training samples and therefore ground truth be available for the 'class of interest' plus all confusion classes defined by the multispectral data. This paper will consider the problem of designing a two-class Bayes classifier which will classify data into the 'class of interest' or the 'other' classes but will require only labeled training samples from the 'class of interest' to design the classifier. Thus, this classifier minimizes the need for ground truth. For these reasons, the classifier is referred to as a single-class classifier. A procedure for evaluating the overall performance of the single-class classifier in terms of the probability of error will be discussed. (Author)

**A76-18913** **Recursive estimation of proportions in earth observations.** D. Kazakos (Rice University, Houston, Tex.). In: Symposium on Machine Processing of Remotely Sensed Data, 2nd, West Lafayette, Ind., June 3-5, 1975, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 2A-40 to 2A-43. 12 refs.

In earth observations problems, we usually have the situation of knowing accurately the probability density functions of the several classes of interest, and we need to classify a set of observations with unknown class proportions. The observations are in  $n$ -dimensional space, where  $n$  is the number of spectral bands. Two recursive algorithms for classifying the observations and estimating the prior

probabilities are described. The first one achieves simultaneous classification of pixels and estimation of prior probabilities (or proportions) and the second one estimates the proportions in a recursive fashion. There is a similarity of the second approach to maximum likelihood estimation, but the proposed method requires less computer time. (Author)

**A76-18916 \*** **A general non-parametric classifier applied to discriminating surface water from terrain shadows.** W. G. Eppler (Lockheed Electronics Co., Inc., Aerospace Systems Div., Houston, Tex.). In: Symposium on Machine Processing of Remotely Sensed Data, 2nd, West Lafayette, Ind., June 3-5, 1975, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 2B-23 to 2B-36. 6 refs. Contract No. NAS9-12200.

A general non-parametric classifier is described in the context of discriminating surface water from terrain shadows. In addition to using non-parametric statistics, this classifier permits the use of a cost matrix to assign different penalties to various types of misclassifications. The approach also differs from conventional classifiers in that it applies the maximum-likelihood criterion to overall class probabilities as opposed to the standard practice of choosing the most likely individual subclass. The classifier performance is evaluated using two different effectiveness measures for a specific set of ERTS data. (Author)

**A76-18919 \*** **Resolution enhancement of ERTS imagery.** C. D. McGillem, G. Mobasseri (Purdue University, West Lafayette, Ind.), and T. E. Riemer (Texaco, Inc., Bellaire, Tex.). In: Symposium on Machine Processing of Remotely Sensed Data, 2nd, West Lafayette, Ind., June 3-5, 1975, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 3A-21 to 3A-29. Contract No. NAS9-14016; Grant No. N64-15-005-112.

A method is described for combined interpolation and enhancement of ERTS multispectral scanner data sets. Previous research has shown that good enhancement is most easily achieved when there are a large number of data points contained within the radius of gyration of the system point spread function. This requirement can be met using ERTS data by interpolating the data before enhancement. By varying the interpolation scale factor the data set can be empirically matched to a precalculated optimum restoration filter. Once the proper match of data and filter has been found the enhancement can be carried out directly or the enhancement and interpolation operations can be combined into a single filter thereby greatly reducing the processing time. Experimental results of applying this technique are shown along with more conventional methods of image interpolation and enlargement. (Author)

**A76-18925** **An acquisition and processing equipment for SR and VHRR picture data of weather satellites of the NOAA 3 type.** R. Buecklein, E. Krauth, M. Mozer, and R. Stoiber (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Satellitenelektronik, Oberpfaffenhofen, West Germany). In: Symposium on Machine Processing of Remotely Sensed Data, 2nd, West Lafayette, Ind., June 3-5, 1975, Proceedings.

New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 4A-19 to 4A-31.

Picture processing equipment was designed to handle picture data from scanning radiometers on board meteorological satellites of the NOAA 3 type. The received analog signals are digitized and stored on computer compatible tapes. Simultaneously the data are fed to a picture-printer to get quick-look pictures. The picture-printer is an opto-mechanical scanner of high precision. The rotation of the film-drum of this device is synchronized with the rotation of the scanning mirrors on board the satellite. Pictures of the scanning radiometer system (SR) as well as those of the very high resolution scanning radiometer-system (VHRR) can be printed with the same film-writer. This device also can be controlled by the data-processor



to print the processed picture data. An interactive TV-monitor-system provides the possibility for semiautomatic picture data processing. (Author)

**A76-19136** Geometric problems in side-looking radar imaging. L. C. Graham. In: International Society of Photogrammetry, Symposium, Stuttgart Universität, Stuttgart, West Germany, September 2-6, 1974, Proceedings. Munich, Verlag der Bayerischen Akademie der Wissenschaften, 1975, p. 199-206.

The operation of airborne synthetic aperture side-looking radar systems for remote sensing is described. Short radar pulses are transmitted through an antenna beam which is wide in the vertical direction and narrow in the horizontal direction. A portion of the radiation scattered from the terrain is received back at the aircraft and a two dimensional record of this backscattered radiation is constructed. Image geometry associated with slant range measurement and along-track coordinate is discussed. Various image error sources are considered, including aircraft position altitude uncertainty, elevation displacement, and scale and pointing errors. B.J.

**A76-19137** Radargrammetric point determination 'PRO-RADAM'. F. Leberl. In: International Society of Photogrammetry, Symposium, Stuttgart Universität, Stuttgart, West Germany, September 2-6, 1974, Proceedings. Munich, Verlag der Bayerischen Akademie der Wissenschaften, 1975, p. 207-215.

PRORADAM (Proyecto Radargrametrico del Amazonas) is a project for reconnaissance type mapping of about 360,000 sq km within Colombia, using airborne sidelooking radar (SLAR). The paper deals with the procedures used and problems encountered in a planimetric adjustment of the block of SLAR image strips, making use of 44 ground control points. The adjustment was divided into 2 steps: block formation and external adjustment. Accuracies obtained can be evaluated by comparing the adjusted block with independent ERTS-MSS images. Root-mean-square discrepancies between ERTS and SLAR amount to plus or minus 1.5 mm at an image scale 1:400,000. (Author)

**A76-19138** A simulation system for theoretical analysis of radar restitution and a test by adjustment. G. Dowdell. In: International Society of Photogrammetry, Symposium, Stuttgart Universität, Stuttgart, West Germany, September 2-6, 1974, Proceedings. Munich, Verlag der Bayerischen Akademie der Wissenschaften, 1975, p. 216-229. 7 refs.

Since flight data is generally not available for geometric restitution of remote-sensor radar imagery, it is necessary to simulate such data together with radar image coordinates. The SIMUL program, which employs Fourier series and random values is used to simulate the flight path and to produce the image coordinates. The imagery equations in SIMUL serve as the basis for the error equations in the block adjustment in the SLAR program. This program determines three-dimensional Gauss-Kruger coordinates of unknown image points by using a few control points. B.J.

**A76-19145** Geometric correction of ERTS-1 MSS images. R. B. Forrest. In: International Society of Photogrammetry, Symposium, Stuttgart Universität, Stuttgart, West Germany, September 2-6, 1974, Proceedings. Munich, Verlag der Bayerischen Akademie der Wissenschaften, 1975, p. 340-357. 10 refs.

ERTS-1 images have three levels of accuracy, corresponding to the effort applied to processing. All images are system-corrected to a circular standard error of 750 meters. A selected 5 to 10 percent of the images are processed further, reducing the error to about 100 meters. Research indicates that the limiting error is less than 40 meters. ERTS image processing equipment and imaging models are described. (Author)

**A76-19146** Mars - A processing system for the mapping of remote sensing data. E. Clerici, D. Eckhart, and K. Kubik. In: International Society of Photogrammetry, Symposium, Stuttgart Universität, Stuttgart, West Germany, September 2-6, 1974, Proceedings. Munich, Verlag der Bayerischen Akademie der Wissenschaften, 1975, p. 358-361.

The basis of Mars is a large computer system, which includes the PDP 11 minicomputer, used to control the hardware for processing the remote sensor data. Its software design is developed for a multiprogramming environment. The hardware consists of: (1) ASTROSCAN, a densitometer of utmost flexibility, (2) REMS, a device, coupled to the minicomputer, for rectifying digitally recorded scanner images, and (3) RADEX hard, the radar extractor developed for processing SLAR imagery. The software consists of: (1) KARIN which transforms selectively digitized image points to the map coordinate system, (2) MARE for producing temperature maps from IRLS signals, and (3) SILOS for transforming Side Scan Sonar image features into a suitable map system. B.J.

**A76-19179 \*** Digital image processing of earth observation sensor data. R. Bernstein (IBM Corp., Federal Systems Div., Gaithersburg, Md.). IBM Journal of Research and Development, vol. 20, Jan. 1976, p. 40-57. 20 refs. Contract No. NAS5-21716.

This paper describes digital image processing techniques that were developed to precisely correct Landsat multispectral earth observation data and gives illustrations of the results achieved, e.g., geometric corrections with an error of less than one picture element, a relative error of one-fourth picture element, and no radiometric error effect. Techniques for enhancing the sensor data, digitally mosaicking multiple scenes, and extracting information are also illustrated. (Author)

**A76-20119** Skylab experiment results. R. Edgar. Space-flight, vol. 18, Feb. 1976, p. 59-67. 30 refs.

The Skylab program is reviewed and its impact estimated. Skylab contributions to solar study include: films of the sun, studies of coronal holes, artificial occultation of the sun (not effective in the earth's scattering atmosphere) in studying the perihelion passage of Comet Kohoutek, and computer-processed images of solar phenomena; solar research instruments mounted in Skylab are listed. Materials science experiments on board Skylab are reviewed, including the Materials Processing Facility, the Multipurpose Electrical Furnace System, and experiments on zero-g materials processing techniques. Medical experiments and symptomatology in orbit are discussed. Earth resources mapping and the requisite Skylab equipment are reviewed. R.D.V.

**A76-20376** Radar Meteorology Conference, 16th, Houston, Tex., April 22-24, 1975, Preprints. Conference sponsored by the American Meteorological Society. Boston, American Meteorological Society, 1975. 530 p. \$20.

Subjects of instrumentation and signal processing are considered, taking into account the estimation of spectral density mean and variance by covariance argument techniques, a weather radar scan converter/color display, and the design and application of a remote radar display. Other studies discussed are related to precipitation in convective storms, the kinematics of convective storms, fundamental investigations and techniques, motion fields, acoustic echo sounding of the atmosphere, simultaneous acoustic and radar studies of the atmosphere, new techniques for clear air probing, operational applications, precipitation statistics, precipitation physics, and precipitation measurement and Z-R relationships. Individual items are announced in this issue. G.R.

**A76-20383 #** Ground truth tests of the dual-wavelength radar detection of hail. P. J. Eccles (National Center for Atmospheric Research, Boulder, Colo.). In: Radar Meteorology Conference, 16th, Houston, Tex., April 22-24, 1975, Preprints. Boston, American Meteorological Society, 1975, p. 41, 42. NSF-sponsored research.

The method for hail detection employed in the investigation makes use of a radar which emits two frequencies of microwave radiation. An analysis is performed with the two signals which are returned from an individual storm pulse volume. The determination of the presence of hail in real time is based on a comparison of this analysis with the analysis of signals from an adjacent volume. The method employed in the reported studies utilizes a slight modification in the conventional procedure to obtain data concerning the dominant hail size in addition to the information provided with respect to the location and the extent of hailstreaks. G.R.

**A76-20429 #** Correcting airborne radar data for precipitation attenuation. H. V. Senn (Miami, University, Coral Gables, Fla.). In: Radar Meteorology Conference, 16th, Houston, Tex., April 22-24, 1975, Preprints. Boston, American Meteorological Society, 1975, p. 366-369. 8 refs. Contract No. NOAA-03-4-022-98.

The errors involved in airborne radar measurements of hurricane precipitation patterns at attenuating wavelengths are analyzed, and two methods of correcting the data are discussed. An aircraft moving to and through hurricane cells can obtain multiple viewings of the precipitation rate. The highest value observed over a time period consistent with the precipitation and radar characteristics is taken as the closest approximation of the true value (the 'highest observed' approximation). Preliminary analysis of radar video data from hurricane Ellen (1972) indicates that the highest observed approximation for a cell at a given range and azimuth from the hurricane center is valid only for short (2-4 min) time periods near the center itself, but can be used at greater distances for longer periods. In the ground truth approximation, foil samples and other airborne observations obtained simultaneously with radar data are used to 'calibrate' the radar. C.K.D.

**A76-23547 #** Information through color imagery. A. P. Colvocoresses. *U.S. Geological Survey, Journal of Research*, vol. 3, Mar.-Apr. 1975, p. 127-129.

In remote sensing, we should use color to display data more meaningfully, not to re-create the scene. Color infrared film lets us apply color with additional meaning, even though we introduce a false color response. Although the marginal gray scale on an ERTS image may indicate balance between the green, red, and infrared bands, an although each band may be printed in a primary color, tests show that we are not fully applying the three primary colors. Therefore, contrast in the green band should be raised. For true three-color remote sensing of the earth, we must find two generally meaningful signatures in the visible spectrum, or perhaps extend our spectral range. Before turning to costly digital processing, we should explore analog processing. Most ERTS users deal with relative spectral radiance; the few concerned with absolute radiance could use the computer-compatible tapes or special annotations. (Author)

**A76-23679 #** Automatic processing of images by means of a discrete method using a digital computer (Avtomaticheskaya obrabotka izobrazhenii diskretnym sposobom na baze ETsVM). Iu. P. Kienko, L. I. Zlobin (Gosudarstvennyi Nauchno-Issledovatel'skii i Proizvodstvennyi Tsentr Priroda, USSR), V. K. Zlobin, A. A. Anurkin, E. P. Korolev (Riazanskii Radiotekhnicheskii Institut, Ryazan, USSR), and Iu. S. Tiufin (Tsentral'nyi Nauchno-Issledovatel'skii Institut Geodezii, Aeros'emki i Kartografii, Moscow, USSR). *Geodeziia i Aerofotos'emka*, no. 1, 1975, p. 51-54. In Russian.

A system consisting of an image input-output device and a digital computer for the photogrammetric processing of airborne and spaceborne photographic images with the aim of transforming these images into a given map projection is described. The image input-output device is realized on the basis of reconstructed phototelegraphic equipment. Upon image input, a video signal formed in the image analyzer goes to the analog-to-digital converter

where it is coded into an optical density code, and then it goes through the interface channel into the computer. Upon output of the image signal, a machine word is transmitted from the computer into the digital-to-analog converter where the optical density code is converted into an equivalent video signal which is registered on photographic film. The software aspects of the system are discussed with emphasis on the elaboration of macrocommands addressed to the control program. B.J.

**A76-23685 #** Mathematical modeling of topographic surfaces (Matematicheskoe modelirovanie topograficheskikh poverkhnostei). E. K. Korchagin. *Geodeziia i Aerofotos'emka*, no. 1, 1975, p. 93-100. 10 refs. In Russian.

The paper considers various aspects of approximation in digital modeling applied to the reconstruction of topographic surfaces from photogrammetric and geodetic data. It is indicated that the most common methods for modeling topographic surfaces are the interpolation method and the quadratic approximation of a discretely given function. Linear approximation is shown to be the most characteristic for the first stage of modeling. Further stages demonstrate an increase in the order of the topographic surface modeled (nonlinear models). The initial data are optimized by means of a geomorphological approach with selection of structural and orographic carriers of the initial data. The step approximation and the selection of the approximating polynomial are treated in detail. A table is provided listing the various modeling methods, their names in different countries, and the corresponding carriers of initial data. B.J.

**A76-23689 #** Method for the automatic coordination and determination of the extent of branched-out linear objects on maps and aerial photographs (Sposob avtomaticheskogo koordinirovaniia i opredeleniia protiazhenosti razvetvlennykh lineinykh ob'ektov na kartakh i aerosnimkakh). E. E. Shiriaev and G. G. Gorbunov (Moskovskii Gosudarstvennyi Universitet, Moscow, USSR). *Geodeziia i Aerofotos'emka*, no. 1, 1975, p. 119-125. In Russian.

**A76-23690 #** Technological schemes for the comparison of the contour parts of large-scale topographic maps by means of computers and automatic coordination graph devices (Tekhnologicheskie skhemy sostavleniia konturnoi chasti krupnomashtabnykh topograficheskikh kart i planov s ispol'zovaniem elektronnykh vychislitel'nykh mashin i avtomaticheskikh koordinatografov). V. Ia. Shvidkii. *Geodeziia i Aerofotos'emka*, no. 1, 1975, p. 127-136. 8 refs. In Russian.

**A76-24026** Laser recording and information handling technology; Proceedings of the Seminar, San Diego, Calif., August 21, 22, 1974. Seminar sponsored by the Society of Photo-Optical Instrumentation Engineers. Edited by L. Beiser (CBS Laboratories, Stamford, Conn.), Palos Verdes Estates, Calif., Society of Photo-Optical Instrumentation Engineers (SPIE Proceedings, Volume 53), 1975. 157 p. \$21.

Recent progress in laser recording techniques, components, and applications is reviewed, along with laser scanning and modulation. With the advent of the laser as a high-intensity, monochromatic, collimated light source, the potential limitations of available recorders are minimized, if not eliminated. Featured topics include unconventional media for laser recording and display, holographic storage, optical video disk technology, laser beam recording on transparent electrophotographic film, laser microprinter, and image recording requirements for earth observation applications in the next decade. S.D.

**A76-24035 \*** Image recording requirements for earth observation applications in the next decade. B. Peavey and J. Y. Sos (NASA, Goddard Space Flight Center, Greenbelt, Md.). In: Laser

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recording and information handling technology; Proceedings of the Seminar, San Diego, Calif., August 21, 22, 1974. Palos Verdes Estates, Calif., Society of Photo-Optical Instrumentation Engineers, 1975, p. 106-115.

Future requirements for satellite-borne image recording systems are examined from the standpoints of system performance, system operation, product type, and product quality. Emphasis is on total system design while keeping in mind that the image recorder or scanner is the most crucial element which will affect the end product quality more than any other element within the system. Consideration of total system design and implementation for sustained operational usage must encompass the requirements for flexibility of input data and recording speed, pixel density, aspect ratio, and format size. To produce this type of system requires solution of challenging problems in interfacing the data source with the recorder, maintaining synchronization between the data source and the recorder, and maintaining a consistent level of quality. Film products of better quality than is currently achieved in a routine manner are needed. A 0.1 pixel geometric accuracy and 0.0001 d.u. radiometric accuracy on standard (240 mm) size format should be accepted as a goal to be reached in the near future. S.D.

**A76-25070 \*** The preprocessing of multispectral data. II (Zur Vorverarbeitung multispektraler Daten. II). F. Quiel (Karlsruhe, Universität, Karlsruhe, West Germany). *Bildmessung und Luftbildwesen*, vol. 44, Mar. 1, 1976, p. 61-65. 5 refs. In German. Contract No. NAS9-13380; Grant No. NGL-15-005-112.

It is pointed out that a correction of atmospheric effects is an important requirement for a full utilization of the possibilities provided by preprocessing techniques. The most significant characteristics of original and preprocessed data are considered, taking into account the solution of classification problems by means of the preprocessing procedure. Improvements obtainable with different preprocessing techniques are illustrated with the aid of examples involving Landsat data regarding an area in Colorado. G.R.

**A76-25956** Data management - Key to environmental quality assessment. T. S. Austin (NOAA, Environmental Data Service, Washington, D.C.). In: International Conference on Environmental Sensing and Assessment, Las Vegas, Nev., September 14-19, 1975, Proceedings. Volume 2. New York, Institute of Electrical and Electronics Engineers, Inc., 1976, p. 1 25-1 to 4 25-1.

Data and data flow must be primary concerns of environmental quality monitoring, assessment, and warning systems. The scope and complexity of programs such as the UNESCO/IOC GIPME (Global Investigation of Pollution of the Marine Environment) demand a strong, structured, and thoroughly integrated data management system if such massive efforts are to be fruitful. This paper describes a still-evolving generic concept for such a system. The concept incorporates knowledge and experience gained in large-scale, interdisciplinary data collection and interpretation programs such as BOMEX (Barbados Oceanographic and Meteorological Experiment), IFYGL (the International Field Year for the Great Lakes), and GATE (the Atlantic Tropical Experiment of the ICSU Global Atmospheric Research Program); a prototype data management system developed for U.S. programs in the IDOE (International Decade of Ocean Exploration); and the development of a NOAA environmental quality monitoring plan for proposed oil and gas activities on the U.S. Continental Shelf. (Author)

**A76-26390** horizon profile checkpoints for low-altitude aircraft. G. E. Carlson, G. L. Bair, and C. M. Benoit (Missouri, University, Rolla, Mo.). *IEEE Transactions on Aerospace and Electronic Systems*, vol. AES-12, Mar. 1976, p. 152-161. 12 refs. Contract No. N00014-69-A-0141-0009. NR Project 387-076.

A technique for utilizing on-board sensed horizon profiles and computer stored reference horizon profiles to provide navigation

checkpoints for low-altitude aircraft is described. The technique has been analyzed using digitized terrain data and computer simulations to select the best method of horizon profile comparison, to determine horizon data density requirements, and to provide performance comparisons, system error limitations, and tradeoffs. Results of these analyses are shown to support feasibility conclusions and system parameter tradeoffs. (Author)

**A76-27071 #** An advanced electrochemical ozone radiosonde (Eine weiterentwickelte elektrochemische Ozonradiosonde). K. Rönnebeck (Deutsche Akademie der Wissenschaften, Zentrum für wissenschaftlichen Gerätebau, Berlin, East Germany) and D. Sonntag (Meteorologischer Dienst, Instrumentenamt, Berlin, East Germany). *Zeitschrift für Meteorologie*, vol. 26, no. 1, 1976, p. 15-19. 5 refs. In German.

The ozone radiosonde considered represents an improvement of the radiosonde design described by Röthig and Sonntag (1969). The basic electrochemical reactions and relations utilized by the radiosonde are discussed along with the composition of the device. The considered device is to be used together with the Soviet radiosonde RKS 5 as a balloon-borne instrument for altitudes up to 35 km. The principles of operation of the ozone radiosonde are examined and evaluation and correction procedures are described. The device is used to obtain data concerning the ozone concentration in the atmosphere above the territory of the German Democratic Republic. G.R.

**A76-27422** Air photo-tones and soil properties - Implications for interpreting satellite imagery. R. Evans (Soil Survey of England and Wales, Harpenden, Herts., England), J. Head (East Anglia, University, Norwich, England), and M. Dirkszwaiger (National College of Agricultural Engineering, Silsoe, Beds., England). *Remote Sensing of Environment*, vol. 4, no. 4, 1976, p. 265-280. 35 refs.

The use of image- or photo-tone in air photo analysis of soils is examined along with identification of soil properties governing photo-tone response of soils and different properties giving similar tonal response. Correlation of photo-tone and organic matter content is discussed in terms of photo-density which is a measure of the amount of light passing through a part of the photographic print and is dependent on photo-tone. It is shown that tonal density alone cannot be used as a definitive criterion for a particular soil nor for predicting particular soil properties. In many places, photo-tones could be due to transient features like surface water-logging, stubble remaining on the surface after ploughing, different dates of cultivation, or difference in photo exposure. Without experience of the land concerned, or unless tone changes correlate with previously mapped geological features or land forms, photo-tone changes should be treated with caution. The resolution of satellite imagery will have to be improved before even small-scale (1:50,000) photographs are made redundant for mapping soils. S.D.

**A76-27977** Photomaps from non-conventional imagery. S. E. Masry, E. Derenyi (New Brunswick, University, Fredericton, Canada), and B. G. Crawley (Gestalt International, Ltd., Vancouver, Canada). *Photogrammetric Engineering and Remote Sensing*, vol. 42, Apr. 1976, p. 497-501. Research supported by the Defence Research Board of Canada.

A method for the rectification of infrared and radar imagery was developed using the Gestalt Photomapper, a device used for the production of orthophotos. The imagery strip to be rectified is placed on one of two stage carriages, each of which can move in the x or y direction under computer control. The scanning raster is formed by a cathode ray tube below each carriage and focused onto the plane of the image by an optical system. Rectification proceeds in a patch-by-patch mode. The correction function is used in forming the scanning raster within each area. The method is applicable for the rectification of any type of imagery in which the distortion can be expressed as a continuous function. C.K.D.

**A76-27979 \*** Ground location of satellite scanner data. E. F. Puccinelli (NASA, Goddard Space Flight Center, Greenbelt, Md.). *Photogrammetric Engineering and Remote Sensing*, vol. 42, Apr. 1976, p. 537-543.

This paper presents simple and accurate mathematical formulation for determining the ground location of remote sensor data. The techniques used are based on elementary concepts of differential geometry and lead to the development of a relation that gives location as a function of surface ellipticity, satellite position, velocity, attitude, and scanner orientation. The formula lends itself to simply computer coding and will hopefully lead to a standardization of the various techniques which have been developed to solve this problem. (Author)

**A76-27980** Computer analysis of photo pattern elements. J. W. Mark (USAF, Offutt AFB, Neb.). *Photogrammetric Engineering and Remote Sensing*, vol. 42, Apr. 1976, p. 545-550. 5 refs.

Much success has been achieved in collection techniques for remote sensing data, yet more investigation remains to be done in processing techniques. This paper describes an attempt to adopt the classical Photo Pattern Element techniques to computer processing. Two approaches were tried; the first had limited success but the second was successful. Interpretation time was reduced, as was the skill level required of the interpreter, and the Photo Pattern Element concept was shown to be highly flexible and adaptable to computer processing. (Author)

**A76-28052** The effects of preprocessing transformations on image discrimination. J. H. Hansen (Tennessee, University, Tullahoma, Tenn.). In: *Remote sensing of earth resources. Volume 4 - Proceedings of the Fourth Annual Conference on Earth Resources*, Tullahoma, Tenn., March 24-26, 1975. Tullahoma, University of Tennessee, 1975, p. 1-19. 18 refs. USDA Project 1670; USDA Project 1650.

Two separate data sets were used to test the effects of selected preprocessing transformations on the accuracy of group discrimination. The first data set consisted of 12 images of Munsell color chips having similar color while the second data set was of 12 images of vegetation contained on an aerial infrared transparency. Transmittance measurements were made with a Leitz microspectrophotometer. Raw transmittance measurements taken at three wavelengths for each observation were transformed to three-ranked values for (1) internal transmittance, (2) integral density, (3) analytical density, (4) 1964 CIE color system, and to the two-ranked values for (5) ratioed transmittance, (6) ratioed density, and (7) 1960 CIE-UCS color system. A multivariate statistical test expressed in terms of critical value distances was used for the test of statistical significance between groups. (Author)

**A76-28055** The future of human computer processed ERTS MSS data in resource inventory, mapping and assessment. J. D. Nichols (California, University, Berkeley, Calif.). In: *Remote sensing of earth resources. Volume 4 - Proceedings of the Fourth Annual Conference on Earth Resources*, Tullahoma, Tenn., March 24-26, 1975. Tullahoma, University of Tennessee, 1975, p. 69-76.

The organization of an interdisciplinary, inter-agency renewable resource survey, inventory and mapping system based on computer analyzed Landsat multispectral scanner data is described. The characteristics of this cost-effective system are broad uniform data base, suitable spatial and spectral resolution, direct computer compatibility, periodic and systematic coverage and geometric fidelity. A brief description is given of the steps that would be used for inventory, assessment and mapping of the renewable resources using Landsat data. B.J.

**A76-28057** Use of infra red imagery in the selection of a port facility western Australia. B. R. Moore and T. C. Wachs

(Kentucky, University, Lexington, Ky.). In: *Remote sensing of earth resources. Volume 4 - Proceedings of the Fourth Annual Conference on Earth Resources*, Tullahoma, Tenn., March 24-26, 1975.

Tullahoma, University of Tennessee, 1975, p. 99-104.

Color enhancement and structure analysis of ERTS infrared imagery were applied to the selection of the most suitable of two port sites for a proposed facility on the northwest coast of Australia. Navigation charts were corrected from the imagery and structural and geological information of the nearshore sea floor obtained from the use of Bands 4, 5 and 7 with Band 4 being the most helpful for data beneath the water. An ancient drowned river channel was located for the port and channel site at Ronsard Island and subsequent drilling revealed no resistant bedrock in accordance with predictions from the imagery. (Author)

**A76-28067** Statewide wet land mapping using Landsat imagery. B. E. Frazier (Washington State University, Pullman, Wash.), R. W. Kiefer (Wisconsin, University, Madison, Wis.), and T. M. Krauskopf (Wisconsin Department of Administration, Madison, Wis.). In: *Remote sensing of earth resources. Volume 4 - Proceedings of the Fourth Annual Conference on Earth Resources*, Tullahoma, Tenn., March 24-26, 1975. Tullahoma, University of Tennessee, 1975, p. 267-280.

A statewide wet land map of Wisconsin has been prepared at a scale of 1:500,000 using Landsat images as a data source and an additive color viewer as a data analysis system. Wet land areas, for the purpose of this investigation, were those which had enough water in them in June to adversely affect the infrared reflectance of plants growing in them. This includes areas with wet land cover types (marsh, sedge meadow, shrub-carr, and lowland forest) and poorly drained agricultural cropland areas. The primary criteria for delineation of wet land patterns were the reduced infrared reflectance of broad leaf plants growing in wet areas, the dark red tone of spruce bogs, and the black color of organic soil areas. These patterns were best seen with the additive color viewer using Landsat Band 5 with no filter in combination with Landsat Band 7 with a red filter. Wisconsin's Department of Administration will use the wet land map for statewide land use planning. (Author)

**A76-28078 \*** The use of hand-held 35 mm color infrared imagery for estimates of suspended solids - A progress report. W. F. Miller, F. D. Whisler, H. R. Robinette, D. Finnie, and T. Cannon (Mississippi State University, Mississippi State, Miss.). In: *Remote sensing of earth resources. Volume 4 - Proceedings of the Fourth Annual Conference on Earth Resources*, Tullahoma, Tenn., March 24-26, 1975. Tullahoma, University of Tennessee, 1975, p. 469-480. Grant No. NGL-25-001-054.

A cost-effective aerial surveillance technique is proposed for detection and identification of suspended solids which would be operational for both governmental monitoring organizations and private individuals operating catfish farms. Sixteen catfish ponds were flown daily for seven days using two hand-held 35 mm cameras with both Kodachrome X and Ektachrome infrared film. Hue, value, and chroma designations were recorded for each pond on each date by three interpreters, and the accepted color was that recorded by at least two of the interpreters, or if there was a three hue range, the median was accepted. Relations between suspended solids and color designations were analyzed graphically, and chroma was discarded due to an apparent lack of correlation. The data obtained were then analyzed by multiple regression. Significant correlations were revealed between hue and value and total and inorganic suspended solids. If perfected, this technique could be developed to sufficient accuracy for large-scale reconnaissance surveys to monitor the quality of rivers and streams. S.D.

**A76-28085 \*** Evaluation of the dual differential radiometer for remote sensing of sediment and chlorophyll in turbid waters. W. G. Witte (NASA, Langley Research Center, Hampton, Va.). In:

Remote sensing of earth resources. Volume 4 - Proceedings of the Fourth Annual Conference on Earth Resources, Tullahoma, Tenn., March 24-26, 1975. Tullahoma, University of Tennessee, 1975, p. 577-589. 5 refs.

The dual differential radiometer (DDR) was tested to determine its capability for measuring suspended sediment and chlorophyll in turbid waters. Measurements were obtained from a boat dock and from a helicopter with combinations of sample and reference filters with peak transmissions at various wavelengths. Water samples were taken concurrently and were analyzed for light scattering, particle count, and total chlorophyll. Least-squares estimates of the linear relationship between DDR output and the water parameters yielded correlation coefficients of less than 0.7. Under the turbid water conditions of the present tests, the DDR did not accurately measure either suspended sediment or chlorophyll. A precise knowledge of the spectral signatures of various pollutants might enable appropriate filters to be selected for tuning the DDR to monitor a particular pollutant. (Author)

**A76-28089** Real-time printing of SR- and VHRR pictures from the NOAA 3-type weather satellites and elimination of signal propagation delay effects between the satellite and the ground station. M. Mozer and R. Buecklein (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Satellitenelektronik, Oberpfaffenhofen, West Germany). In: Remote sensing of earth resources. Volume 4 - Proceedings of the Fourth Annual Conference on Earth Resources, Tullahoma, Tenn., March 24-26, 1975. Tullahoma, University of Tennessee, 1975, p. 635-650.

As a support to the meteorologists, a picture data processing equipment was developed and realized to process and to print pictures from weather satellites. This equipment comprises a data acquisition system, a processor with an interactive monitoring system and a picture printer. The video picture data of the demodulator output are digitized and preprocessed by the data acquisition system either to be interfaced to the processor or to control a film-writer in the on-line mode to get a quick-look picture. The picture printer is an opto-mechanical scanner which is modified in a manner that by printing a picture, the film-drum rotates synchronously with the scanning system on board the satellite while the picture data which are stored in a core-memory are transferred to the writer by a pulse which marks the beginning of the scan-line on the film drum.

(Author)

**A76-28090** Measurements of heat emissions from big cities in Europe with infrared VHRR data of the NOAA satellite. H. Kaminski (Ruhr-Universität, Bochum, Sternwarte, Bochum; Essen, Universität, Essen; Duisburg, Universität, Duisburg, West Germany). In: Remote sensing of earth resources. Volume 4 - Proceedings of the Fourth Annual Conference on Earth Resources, Tullahoma, Tenn., March 24-26, 1975. Tullahoma, University of Tennessee, 1975, p. 653-674. 30 refs.

**A76-28092** SYNOP - A versatile tool in comparing differences of ERTS, RB-57 and ground-based data banks. W. W. Kuhlow (Wisconsin, University, Madison, Wis.). In: Remote sensing of earth resources. Volume 4 - Proceedings of the Fourth Annual Conference on Earth Resources, Tullahoma, Tenn., March 24-26, 1975. Tullahoma, University of Tennessee, 1975, p. 691-711.

With increasing frequency spatial data banks are being constructed from information derived from remote sensed imagery collected by satellite and airborne sensors to complement existing data banks built from on-the-ground observations. When comparing the data banks derived from these three sources for the same geographical area, two areas of concern naturally arise: differences in spatial resolution and differences in time of data collection. This paper addresses these two problems in the context of results derived from a computer program, SYNOP, developed to easily compare the

differences and similarities in the selection of a corridor route for the same area when the data banks were derived from ERTS-1, RB-57 (high altitude aircraft), and conventional data, and to present the data in such a format that changes in land cover due to the passage of time are easy to detect and interpret. (Author)

**A76-28093** Reflections concerning machine-aided analysis of ERTS-1 MSS data - Common fallacies and misconceptions. S. Sinnock and W. N. Melhorn (Purdue University, West Lafayette, Ind.). In: Remote sensing of earth resources. Volume 4 - Proceedings of the Fourth Annual Conference on Earth Resources, Tullahoma, Tenn., March 24-26, 1975. Tullahoma, University of Tennessee, 1975, p. 713-733. 10 refs.

Four general issues concerning automatic pattern recognition in the analysis of Landsat-1 data have been raised. They are: (1) imprecision inherent in Gaussian assumptions of pattern recognition algorithms; (2) incongruency of spectral classes and ground classes; (3) non-discreteness of boundaries between many natural phenomena; and (4) indeterminacy of spectral class map accuracies. Each of these issues were addressed in a way intended to focus attention on certain conceptual errors that threaten to mislead the analyst. It is shown that if analysis is performed within a fallacious gestalt founded in any of these misconceptions, unnecessary efforts will be wasted on attempts to abstract nonexistent patterns, unreal boundaries and artificial accuracies from the data. B.J.

**A76-28094** Digital correction of ERTS MSS bulk data for high resolution image data base. S. Murai (Tokyo, University, Tokyo, Japan). In: Remote sensing of earth resources. Volume 4 - Proceedings of the Fourth Annual Conference on Earth Resources, Tullahoma, Tenn., March 24-26, 1975. Tullahoma, University of Tennessee, 1975, p. 735-742.

The digital correction of LANDSAT multispectral scanner data of Japan is discussed. The aim of the paper is to specify the selection of control points, to compare the accuracy for different numbers of points, to compare the accuracy of different conversion models and to establish the LANDSAT image data base. Geometric and geographic correction are carried out using five types of polynomials for three different numbers (45, 35 and 25) of control points which are selected on both the LANDSAT digital map and the 1: 50,000 national base map of Japan. Accuracies for these cases were compared in the LANDSAT frame of Tokyo districts and found to be less than one pixel RMS. B.J.

**A76-28097** Evaluation of full-scene registered ERTS MSS imagery using a multitemporal/multispectral Bayes supervised classifier. R. H. Caron (TRW Systems, Redondo Beach, Calif.). In: Remote sensing of earth resources. Volume 4 - Proceedings of the Fourth Annual Conference on Earth Resources, Tullahoma, Tenn., March 24-26, 1975. Tullahoma, University of Tennessee, 1975, p. 783-806. 12 refs.

A technique for precision registration (and simultaneous rectification) of entire ERTS scenes has been developed which yields misregistrations smaller than one picture element throughout an image. A comprehensive study to evaluate this registered imagery as a data base for multispectral signature analysis has been undertaken. Initial results show that for some land use signatures an 8 to 12 per cent improvement in classifier performance obtains when patterns are derived from registered as opposed to single pass imagery. Delineation of urban lands use in the metropolitan Washington area according to four categories - livelihood, residential, mostly open space and water - has been achieved with an average of 88 per cent classification accuracy. (Author)

**N76-16511\*** Canada Centre for Inland Waters, Burlington (Ontario).

**DATA RETRANSMISSION VIA SATELLITES** Final Report H. W. MacPhail, Principal Investigator [1975] 9 p Sponsored by NASA ERTS

(E76-10088; NASA-CR-145991) Avail: NTIS HC \$3.50 CSCL 17B

**N76-16551\*#** Naval Research Lab., Washington, D.C. Space Science Div.

**SKYLAB ALTIMETER OBSERVATIONS OVER TERRAIN Final Report**

Allan Shapiro, June M., Thormodsgard, and J. M. Okada, Principal Investigators Sep. 1975 159 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 EREP

(NASA Order T-4716-B)

(E76-10129; NASA-CR-144498) Avail: NTIS HC \$6.75 CSCL 08B

The author has identified the following significant results. Data obtained by Skylab radar altimeter (S193) over the continental U.S.A. for pass 1 of SL-3 were analyzed to relate radar return signal parameters such as range, power, and waveform to ground track terrain features. The altimeter, which was originally designed for ocean observations, performed predictably well over terrain with moderate to low relief. The maximum return from more complex areas corresponded usually to the lower flatter regions within the seven kilometer diameter footprint. Altimeter measured heights correlated with map topography with an rms deviation of + or - 30 m for terrain topography with large height dispersion (passes 1 and 28) and + or - 5 m for slowly varying terrain (passes 16, 17, and 18). Analysis of the waveform and statistical characteristics of the individual signals indicated that larger signal power was usually related to dominantly specular reflections from patches 100 m or larger. Results established the capability of a spacecraft altimeter system to observe characteristic radar signatures for different types of terrain within the bandwidth restrictions of the AGC and range tracker loops.

**N76-16552\*#** Environmental Research Inst. of Michigan, Ann Arbor.

**S-192 ANALYSIS: CONVENTIONAL AND SPECIAL DATA PROCESSING TECHNIQUES Final Report, 8 Mar. 1973 - 30 Sep. 1975**

R. F. Nalepka, Principal Investigator, J. Morganstern, R. Cicone, J. Sarno, P. Lambeck, and W. Malila Sep. 1975 186 p refs EREP

(Contract NAS9-13280)

(E76-10130; NASA-CR-144506; ERIM-101900-63-F) Avail: NTIS HC \$7.50 CSCL 05B

The author has identified the following significant results. Multispectral scanner data gathered over test sites in southeast Michigan were analyzed. This analysis showed the data to be somewhat deficient especially in terms of the limited signal range in most SDOs and also in regard to SDO-SDO misregistration. Further analysis showed that the scan line straightening algorithm increased the misregistration of the data. Data were processed using the conic format. The effects of such misregistration on classification accuracy was analyzed via simulation and found to be significant. Results of employing conventional as well as special, unresolved object, processing techniques were disappointing due, at least in part, to the limited signal range and noise content of the data. Application of a second class of special processing techniques, signature extension techniques, yielded better results. Two of the more basic signature extension techniques seemed to be useful in spite of the difficulties.

**N76-16572\*** Alaska Univ., Fairbanks. Inst. of Water Resources.

**OPERATIONAL APPLICATIONS OF NOAA-VHRR IMAGERY IN ALASKA**

R. D. Seifert, R. F. Carlson, and D. L. Kane /In NASA, Goddard Space Flight Center Operational Appl. of Satellite Snowcover Observations 1975 p 143-155 refs Sponsored in part by NOAA (For availability see N76-16561 07-43)

(Paper-11) CSCL 08L

Near-real time operational applications of NOAA satellite enhanced thermal infrared imagery to snow monitoring for river

flood forecasts, and a photographic overlay technique of imagery to enhance snowcover are presented. Ground truth comparisons show a thermal accuracy of approximately + or - 1 C for detection of surface radiative temperatures. The application of NOAA imagery to flood mapping is also presented. Author

**N76-16591\*#** Wintek Corp., Lafayette, Ind.

**SATELLITE ON-BOARD PROCESSING FOR EARTH RESOURCES DATA Summary Report**

R. E. Bodenheimer, R. C. Gonzalez, J. N. Gupta, K. Hwang, R. W. Rochelle, J. B. Wilson, and P. A. Wintz Oct. 1975 33 p refs

(Contract NAS2-8327)

(NASA-CR-137757) Avail: NTIS HC \$4.00 CSCL 05B

The feasibility was investigated of an on-board earth resources data processor launched during the 1980-1990 time frame. Projected user applications were studied to define the data formats and the information extraction algorithms that the processor must execute. Based on these constraints, and the constraints imposed by the available technology, on-board processor systems were designed and their feasibility evaluated. Conclusions and recommendations are given. Author

**N76-16592\*#** Wintek Corp., Lafayette, Ind.

**SATELLITE ON-BOARD PROCESSING FOR EARTH RESOURCES DATA Final Report**

R. E. Bodenheimer, R. C. Gonzalez, J. N. Gupta, K. Hwang, R. W. Rochelle, J. B. Wilson, and P. A. Wintz Oct. 1975 199 p refs

(Contract NAS2-8327)

(NASA-CR-137758) Avail: NTIS HC \$7.50 CSCL 05B

Results of a survey of earth resources user applications and their data requirements, earth resources multispectral scanner sensor, technology, and preprocessing algorithms for correcting the sensor outputs and for data bulk reduction are presented along with a candidate data format. Computational requirements required to implement the data analysis algorithms are included along with a review of computer architectures and organizations. Computer architectures capable of handling the algorithm computational requirements are suggested and the environmental effects of an on-board processor discussed. By relating performance parameters to the system requirements of each of the user requirements the feasibility of on-board processing is determined for each user. A tradeoff analysis is performed to determine the sensitivity of results to each of the system parameters. Significant results and conclusions are discussed, and recommendations are presented. Author

**N76-16593\*#** TRW Systems Group, Redondo Beach, Calif. **STUDY OF ON-BOARD COMPRESSION OF EARTH RESOURCES DATA Executive Summary**

A. Habibi Sep. 1975 31 p

(Contract NAS2-8394)

(NASA-CR-137751; TRW-26566) Avail: NTIS HC \$4.00 CSCL 05B

The current literature on image bandwidth compression was surveyed and those methods relevant to compression of multispectral imagery were selected. Typical satellite multispectral data was then analyzed statistically and the results used to select a smaller set of candidate bandwidth compression techniques particularly relevant to earth resources data. These were compared using both theoretical analysis and simulation, under various criteria of optimality such as mean square error (MSE), signal-to-noise ratio, classification accuracy, and computational complexity. By concatenating some of the most promising techniques, three multispectral data compression systems were synthesized which appear well suited to current and future NASA earth resources applications. The performance of these three recommended systems was then examined in detail by all of the above criteria. Finally, merits and deficiencies were summarized and a number of recommendations for future NASA activities in data compression proposed. Author

## 07 DATA PROCESSING AND DISTRIBUTION SYSTEMS

**N76-16594\*** TRW Systems Group, Redondo Beach, Calif.  
**STUDY OF ON-BOARD COMPRESSION OF EARTH RESOURCES DATA** Final Report  
A. Habibi Sep. 1975 224 p refs  
(Contract NAS2-8394)  
(NASA-CR-137752; TRW-26566) Avail: NTIS HC \$7.75 CSCL 05B

For abstract, see N76-16593.

**N76-16595\*** Ohio State Univ. Research Foundation, Columbus, Dept. of Geodetic Science.  
**BASIC RESEARCH AND DATA ANALYSIS FOR THE EARTH AND OCEAN PHYSICS APPLICATIONS PROGRAM AND FOR THE NATIONAL GEODETIC SATELLITE PROGRAM** Semiannual Status Report, Jul. - Dec. 1975  
Jan. 1976 65 p refs  
(Grants NGR-36-008-204; NGL-36-008-093; OSURF Proj. 3820-A1; OSURF Proj. 2514)  
(NASA-CR-146388; SASR-15; SASR-17) Avail: NTIS HC \$4.50 CSCL 08D

Data analysis and supporting research in connection with the following objectives are discussed: (1) provide a precise and accurate geometric description of the earth's surface, (2) provide a precise and accurate mathematical description of the earth's gravitational field, and (3) determine time variations of the geometry of the ocean surface, the solid earth, the gravity field and other geophysical parameters. Author

**N76-16602\*** Avco-Everett Research Lab., Everett, Mass.  
**AIRBORNE OCEANOGRAPHIC LIDAR SYSTEM** Final Report  
Oct. 1975 150 p refs  
(Contract NAS6-2653)  
(NASA-CR-141407) Avail: NTIS HC \$6.00 CSCL 20E

Specifications and preliminary design of an Airborne Oceanographic Lidar (AOL) system, which is to be constructed for installation and used on a NASA Wallops Flight Center (WFC) C-54 research aircraft, are reported. The AOL system is to provide an airborne facility for use by various government agencies to demonstrate the utility and practicality of hardware of this type in the wide area collection of oceanographic data on an operational basis. System measurement and performance requirements are presented, followed by a description of the conceptual system approach and the considerations attendant to its development. System performance calculations are addressed, and the system specifications and preliminary design are presented and discussed. Author

**N76-16604\*** Geological Survey, Tallahassee, Fla. Water Resources Div.  
**SATELLITE RELAY AND PROCESSING OF HYDROLOGIC DATA IN SOUTH FLORIDA** Final Report Water-Resources Investigations

E. J. Wimberly Jul. 1975 21 p refs  
(NASA-CR-146092; PB-244784/5; USGS/WRI-12-75; USGS/WRD-75/050) Avail: NTIS HC \$3.50 CSCL 13B

Management of water in south Florida requires current hydrologic data on water levels and rainfall. This need is being met by a data processing system which provides near-real-time data from remote areas. The flow of data is from data-collection platforms at field sites via LANDSAT-1 satellite to the National Aeronautics and Space Administration's (NASA) ground-receiving stations to the NASA Data Processing Facility at Goddard Space Flight Center to the Miami office of the U. S. Geological Survey to data users. The process requires only a few hours, and current data are provided to water-management agencies in several different forms. The system has proven to be dependable. GRA

**N76-16658\*** Ballistic Research Labs., Aberdeen Proving Ground, Md.  
**A REVIEW OF SOME EXPERIMENTAL MEASUREMENTS ON DETECTORS FOR TRACE CHEMICALS IN THE**

### ATMOSPHERE Final Report

R. D. Shelton and W. A. Wall Jul. 1975 37 p refs  
(DA Proj. 1T1-61102-B-53A)  
(AD-A014946; BRL-1798) Avail: NTIS CSCL 07/4

A number of detectors for trace contaminants in the atmosphere have been developed and tested for environmental measurements, military surveillance, and law enforcement. This paper summarizes the work done by an Army laboratory in the area of detector development and evaluation, and speculates on future evolution in this important area. Detectors subjected to development and evaluation included electric quadrupole mass spectrometers, thin film detectors, biochemical sensors, dogs, ion mobility spectrometers, electron capture devices, condensation nuclei detectors, and remote sensors. Author (GRA)

**N76-17453\*** South Dakota State Univ., Brookings. Remote Sensing Inst.

### BOUNDARY-DETECTION ALGORITHM FOR LOCATING EDGES IN DIGITAL IMAGERY

V. I. Myers, Principal Investigator, M. J. Russell, D. G. Moore, and G. D. Nelson Apr. 1975 32 p Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 EREP

(Contract NAS9-13337)  
(E76-10144; NASA-CR-146153; RSI-SDSU-74-10) Avail: NTIS HC \$4.00 CSCL 08M

The author has identified the following significant results. Initial development of a computer program which implements a boundary detection algorithm to detect edges in digital images is described. An evaluation of the boundary detection algorithm was conducted to locate boundaries of lakes from LANDSAT-1 imagery. The accuracy of the boundary detection algorithm was determined by comparing the area within boundaries of lakes located using digitized LANDSAT imagery with the area of the same lakes planimeted from imagery collected from an aircraft platform.

**N76-17464\*** Army Cold Regions Research and Engineering Lab., Hanover, N.H.

### SKYLAB IMAGERY: APPLICATION TO RESERVOIR MANAGEMENT IN NEW ENGLAND

 Final Report

Saul Cooper (Corp of Engineers, Waltham, Mass.), Duwayne Anderson, Principal Investigators, H. L. McKim, L. W. Gatto, C. J. Merry, and R. K. Haugen Sep. 1975 60 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 EREP

(NASA Order T-4646-B)  
(E76-10155; NASA-CR-144514) Avail: NTIS HC \$4.50 CSCL 08H

The author has identified the following significant results. S190B imagery is superior to the LANDSAT imagery for land use mapping and is as useful for level 1 and 2 land use mapping as the RB-57/RC8 high altitude imagery. Detailed land use mapping at levels 3 and finer from satellite imagery requires better resolution. For evaluating factors that are required to determine volume runoff potentials in a watershed, the S190B imagery was found to be as useful as the RB-57/RC8 high altitude aircraft imagery.

**N76-17478\*** Saint Regis Paper Co., Jacksonville, Fla. Southern Timberlands Div.

### OPERATIONAL CONSIDERATIONS FOR THE APPLICATION OF REMOTELY SENSED FOREST DATA FROM LANDSAT OR OTHER AIRBORNE PLATFORMS

G. Robinson Baker and Terrance P. Fethe In NASA, Lyndon B. Johnson Space Center. NASA Earth Resources Survey Symp. Vol. 1-A: Agr., Environment Jun. 1975 p 115-133 refs

(A-10) CSCL 02F

Research in the application of remotely sensed data from LANDSAT or other airborne platforms to the efficient management of a large timber based forest industry was divided into three

phases: (1) establishment of a photo/ground sample correlation, (2) investigation of techniques for multi-spectral digital analysis, and (3) development of a semi-automated multi-level sampling system. To properly verify results, three distinct test areas were selected: (1) Jacksonville Mill Region, Lower Coastal Plain, Flatwoods, (2) Pensacola Mill Region, Middle Coastal Plain, and (3) Mississippi Mill Region, Middle Coastal Plain. The following conclusions were reached: (1) the probability of establishing an information base suitable for management requirements through a photo/ground double sampling procedure, alleviating the ground sampling effort, is encouraging, (2) known classification techniques must be investigated to ascertain the level of precision possible in separating the many densities involved, and (3) the multi-level approach must be related to an information system that is executable and feasible. Author

**N76-17481\*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

**COMPUTER ANALYSIS AND MAPPING OF GYPSY MOTH LEVELS IN PENNSYLVANIA USING LANDSAT-1 DIGITAL DATA**

Darrel L. Williams *In its* NASA Earth Resources Survey Symp. Vol. 1-A: Agr., Environment Jun. 1975 p 167-181 refs Sponsored in part by McIntire-Stennis Fund and Pennsylvania State Univ.

(A-13) CSCL 02F

The effectiveness of using LANDSAT-1 multispectral digital data and imagery, supplemented by ground truth and aerial photography, was investigated as a new method of surveying gypsy moth (*Porthetria dispar* (L.)) (Lepidoptera: Lymantriidae) defoliation, which has greatly increased in Pennsylvania in recent years. Since the acreage and severity of gypsy moth defoliation reaches a peak from mid-June through the first few days of July, the July 8, 1973, LANDSAT-1 scene was chosen for analysis. Results indicate that LANDSAT-1 data can be used to discriminate between defoliated and healthy vegetation in Pennsylvania and that digital processing methods can be used to map the extent and degree of defoliation. Author

**N76-17482\*** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

**COMPUTER IMPLEMENTED CLASSIFICATION OF VEGETATION USING AIRCRAFT ACQUIRED MULTISPECTRAL SCANNER DATA**

William G. Cibula *In its* NASA Earth Resources Survey Symp. Vol. 1-A: Agr., Environment Jun. 1975 p 183-201 refs

(A-14) CSCL 08F

The use of aircraft 24-channel multispectral scanner data in conjunction with computer processing techniques to obtain an automated classification of plant species association was discussed. The classification of various plant species associations was related to information needed for specific applications. In addition, the necessity for multiple selection of training fields for a single class in situations where the study area consists of highly irregular terrain was detailed. A single classification was illuminated differently in different areas, resulting in the existence of multiple spectral signatures for a given class. These different signatures result since different qualities of radiation upwell to the detector from portions that have differing qualities of incident radiation. Techniques of training field selection were outlined, and a classification obtained from a natural area in Tishomingo State Park in northern Mississippi was presented. Author

**N76-17502\*** Continental Oil Co., Ponca City, Okla.

**SLAR RECONNAISSANCE, MIMIKA-EILANDEN BASIN, SOUTHERN TROUGH OF IRIAN JAYA**

R. S. Wing and J. C. Mueller *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 599-604 refs

(G-1) CSCL 08B

The SLAR was obtained in early April 1973 by means of

an AN/APQ-97 K-band brute-force system. The flight strips are all north-look, with ground-range display, and 60% overlap. The interpretation was compiled on a 1/100,000-scale mosaic, but the actual mapping of contacts, dips, lineaments, and the like, was done on 1/100,000-scale stereo-strips. Initial regional mapping was intended as an aid in determining that part of the Southern Trough most likely to be underlain by relatively unmetamorphosed paralic Kembelangan sandstones ideally interdigitated with marine source and cape shales. SLAR reconnaissance mapping met a subsequent need to rapidly and inexpensively narrow the search to that part of the 'fairway' coincident with a favorable structure. The SLAR mosaic clearly displays the Irian mountains, strongly and gently folded foothills belts, and the southern front of the fold belt south of which is a large complex of alluvial fans. Author

**N76-17505\*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

**THE ANATOMY OF AN ANOMALY**

Nicholas M. Short and Ronald W. Marrs (Wyoming Univ.) *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 641-663 refs

(G-5) CSCL 08G

An anomalous tonal pattern, apparently associated with the Beaver Creek oil field in central Wyoming, was identified using an MSS Band 5 to 4 ratio image made from digital LANDSAT data. This pattern was attributed to an increase in iron with rocks and/or soils which might have resulted from escaping hydrocarbons. The nature of this anomaly was investigated by producing several different combinations of band ratios and by conducting appropriate field studies. The results indicated (1) the existence of a well-defined oval feature related to exposure of iron-cemented red sandstones in a badlands topography, (2) a broader iron-influenced anomaly surrounding this feature, and (3) a spectral response of the rocks, soils, and alluvium making up this iron-colored surface that is readily distinguishable from that of iron-rich reddish Chugwater siltstones exposed in nearby anticlines. The general pattern of the broad anomaly extending beyond the Beaver Creek field is controlled by several factors including variations in vegetation (mainly sage and tall grasses), soil composition and moisture, and topography in addition to variations in iron content of the rock materials. From the available evidence, there is no provable correlation between the oval or the broad anomalies and the distribution of petroleum-producing structures or possible surface alteration effects related to uranium deposits known to occur within this region. Author

**N76-17507\*** Utah Univ., Salt Lake City.

**SUMMARY OF SPACE IMAGERY STUDIES IN UTAH AND NEVADA**

Mead LeRoy Jensen and Philip Laylander *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 673-712 refs

(G-9) Avail: NTIS CSCL 08B

LANDSAT-1, Skylab, and RB-57 imagery acquired within days of each other of the San Rafael swell enabled geological mapping of individual formations of the southern portion of this broad anticlinal feature in eastern Utah. Mapping at a scale of 1/250,000 on an enhanced and enlarged S-190B image resulted in a geological map showing correlative mappable features that are indicated on the geological map of Utah at the same scale. An enhanced enlargement of an S-190B color image at a scale of 1/19,200 of the Bingham Porphyry Copper deposit allowed comparison of a geological map of the area with the space imagery map as fair for the intrusion boundaries and total lack of quality for mapping the sediments. Hydrothermal alteration is only slightly evident on space imagery at Bingham but in the Tintic mining district and the volcanic piles of the Keg and Thomas ranges, Utah, hydrothermal alteration is readily mapped on color enlargements of S-190B (SL-3, T3-3N Tr-2). A mercury soil-gas analyzer was developed for locating hidden mineralized zones which were suggested from space imagery. Author



**N76-17509\*** Alaska Univ., Fairbanks.

## THE APPLICATION OF RADAR IMAGERY TO SPECIFIC PROBLEMS OF INTERIOR ALASKA

P. Jan Cannon /In NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 761-767 refs  
(G-11) CSCL 171

The possible applications are discussed of side-looking airborne radar imagery to specific geomorphic and environmental geologic problems in interior Alaska. The radar imagery described was acquired in July, 1972, by the NASA NP3A aircraft, as part of Mission 209 of the Earth Resources Aircraft Project. The frequency of the radar energy that was transmitted and recorded by the radar system was 16.5 Gigahertz; the wavelength of the radiant energy was about 1.8 centimeters. The radar system operated in both the real aperture and synthetic aperture modes simultaneously. Author

**N76-17510\*** Arkansas Univ., Fayetteville. Dept. of Geology. **LANDSAT IMAGERY ANALYSIS: AN AID FOR PREDICTING LANDSLIDE PRONE AREAS FOR HIGHWAY CONSTRUCTION**

Harold C. MacDonald and Robert S. Grubbs /In NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 769-778 refs

(G-12) CSCL 08B

The most obvious landform features of geologic significance revealed on LANDSAT imagery are linear trends or lineaments. These trends were found to correspond, at least to a large degree, with unmapped faults or complex fracture zones. LANDSAT imagery analysis in northern Arkansas revealed a lineament complex which provides a remarkable correlation with landslide-prone areas along major highway routes. The weathering properties of various rock types, which are considered in designing stable cut slopes and drainage structures, appear to be adversely influenced by the location and trends of LANDSAT defined lineaments. Geologic interpretation of LANDSAT imagery, where applicable and utilized effectively, provides the highway engineer with a tool for predicting and evaluating landslide-prone areas. Author

**N76-17513\*** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

## SMALL-SCALE IMAGERY: A USEFUL TOOL FOR MAPPING GEOLOGICAL FEATURES IN THE TEXAS GULF COASTAL PLAIN

David L. Amsbury, Uel S. Clanton, and Von R. Frierson /In its NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 833-349 refs  
(G-15) CSCL 08B

A sample of satellite imagery includes photographs and multispectral scanner imagery from the Apollo, LANDSAT, and Skylab spacecraft over an area west of Houston, Texas. Large circular features and lineaments can readily be mapped. One of the circular features identified by drainage, vegetation, and soil-tone anomalies, occurs in Fort Bend County, Texas, and covers an area about 25 miles in diameter. Another circular feature lies to the north, immediately west of Houston, and is about 15 miles in diameter. These features represent the surface expression of deeply-buried positive structures. It is recommended that regional geological studies begin with photointerpretations of high-altitude aircraft and synoptic space imagery, space imagery provides the synoptic view of rapid evaluation of large-scale features, and, at enlarged scales, the resolution required for detailed study of selected areas of structures. Author

**N76-17516\*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md. **QUANTIFICATION OF GEOLOGIC LINEAMENTS BY MANUAL AND MACHINE PROCESSING TECHNIQUES**

Melvin H. Podwysocki, Johannes G. Moik (Computer Sciences Corp., Silver Spring, Md.), and Walter C. Shoup (Computer Sciences Corp., Silver Spring, Md.) /In NASA. Lyndon B. Johnson

Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 885-903 refs

(G-19) CSCL 08G

A study was conducted to investigate the effect of operator variability and subjectivity in lineament mapping and to examine methods to minimize or eliminate these problems by use of several machine preprocessing methods. LANDSAT scenes from the Anadarko Basin of Oklahoma and the Colorado Plateau were analyzed as test cases. Four geologists mapped lineaments on an Anadarko Basin scene, using transparencies of MSS bands 4-7, and their results are compared statistically. The total number of fractures mapped by the operators and their average lengths varied considerably, although comparison of lineament directions revealed some consensus. A summary map (785 linears) produced by overlaying the maps generated by the four operators showed that only 0.4% were recognized by all four operators, 4.7% by three, 17.8% by two and 77% by one operator. Two methods of machine aided mapping were tested, both simulating directional filters. One consists of computer (digital) processing of CCTs using edge enhancement algorithms, the other employs a television (analog) scanning of an image transparency which superimposes the original image and one offset in the direction of the scan line. Author

**N76-17520\*** Institut Francais du Pétrole, Rueil-Malmaison. **ENHANCEMENT OF LANDSAT IMAGERY BY COMBINATION OF MULTISPECTRAL CLASSIFICATION AND PRINCIPAL COMPONENT ANALYSIS**

A. Fontanel, C. Blanchet, and C. Lallemand /In NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 991-1012 refs

(G-24) CSCL 08B

Digital enhancement of LANDSAT imagery was obtained by application of principal component analysis separately on each of the classes, previously determined in a multispectral classification step. Each part of the image is thus enhanced whatever its spectral signature may be. A document was obtained which is a synthesis between a conventional image and an ordinary computerized classification. The interpreter can, at the same time, take into account not only the classification but also other features such as context and structure. An example is discussed with the help of geological interpretation. Author

**N76-17521\*** Geological Survey, Reston, Va. **A SEARCH FOR SULFIDE-BEARING AREAS USING LANDSAT-1 DATA AND DIGITAL IMAGE-PROCESSING TECHNIQUES**

R. G. Schmidt, B. B. Clark (IBM Corp., Gaithersburg, Md.), and R. Bernstein (IBM Corp., Gaithersburg, Md.) /In NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 1013-1027 refs

(G-26) CSCL 08G

Two experiments were conducted using LANDSAT-1 multispectral scanner data to identify ground features that are indicators of sulfide-bearing rock. A nearby known sulfide deposit was used as a control. In the first experiment, false-color composites were examined visually to locate possible favorable areas; in the second, favorable areas were classified by digital-computer processing. The results of the experiment show that outcrops of hydrothermally altered and mineralized rock can be identified from LANDSAT-1 data under favorable conditions. The empirical method of digital-computer classification of the multispectral scanner data was relatively unrefined and rapid. The five mineralized prospecting sites identified are in locations that the geologist would not have selected as favorable on the basis of geologic knowledge or photogeologic interpretation at the time of the investigation. Author

**N76-17526\*** Geological Survey, Denver, Colo. **THE MIXTURE PROBLEM IN COMPUTER MAPPING OF TERRAIN: IMPROVED TECHNIQUES FOR ESTABLISHING**

**SPECTRAL SIGNATURE, ATMOSPHERIC PATH RADIANCE, AND TRANSMITTANCE**

Harry W. Smedes, Roland L. Hulstrom (Martin Marietta Aerospace Corp., Denver), and K. Jon Ranson (Colorado State Univ.) *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 1099-1159 refs

**(I-2) CSCL 08B**

The results of LANDSAT and Skylab research programs on the effects of the atmosphere on computer mapping of terrain include: (1) the concept of a ground truth map needs to be drastically revised; (2) the concept of training areas and test areas is not as simple as generally thought because of the problem of pixels that represent a mixture of terrain classes; (3) this mixture problem needs to be more widely recognized and dealt with by techniques of calculating spectral signatures of mixed classes, or by other methods; (4) atmospheric effects should be considered in computer mapping of terrain and in monitoring changes; and (5) terrain features may be used as calibration panels on the ground, from which atmospheric conditions can be determined and monitored. Results are presented of a test area in mountainous terrain of south-central Colorado for which an initial classification was made using simulated mixture-class spectral signatures and actual LANDSAT-1-MSS data. Author

**N76-17527\* TRW Systems Group, Redondo Beach, Calif. SECOND GENERATION DIGITAL TECHNIQUES FOR PROCESSING LANDSAT MSS DATA**

S. S. Rifman, K. W. Simon, and R. H. Caron *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 1161-1175 refs

**(I-3) CSCL 05B**

Results are reported for precision corrected LANDSAT MSS full scene registration of better than 0.5 picture element (rms), utilizing all digital methods. Examples of such registered full scene images are presented and evaluated by two methods: (1) change detection imagery which represents pixel by pixel the difference of corresponding pixel values in the registered data; and (2) direct measurement of registration errors throughout the imagery by means of a highly accurate cross correlation algorithm. Subscene image details illustrate the impact on registration accuracy of two interpolation algorithms. Author

**N76-17529\* Stanford Research Inst., Menlo Park, Calif. MARKING LANDSAT IMAGES WITH SMALL MIRROR REFLECTORS**

Wm. E. Evans *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 1185-1196 ref

**(I-5) CSCL 20F**

Uniquely identifiable artificial landmarks were generated in LANDSAT imagery by making use of specular solar reflection from small, easily transportable mirrors. The results are impressive in well-registered color composite enlargements, where the mirror returns appear as bright white spots. The signatures are unique enough that returns can be readily located in the computer compatible tape records either manually or by machine search. As embodied in experiments to date, the system is entirely passive. Mirrors must be carefully positioned prior to each satellite pass, but the required angle calculations are simple enough to be made on a hand calculator and the required input data are easily available. Possible applications of the technique include providing site identification and geodetic control in remote regions of the earth, enhancement of small targets such as offshore oil derricks, providing atmospheric transmission data coincident with other LANDSAT experiments, and providing a nearly perfect optical point source for overall system checkout. Author

**N76-17533\* Ecole des Mines, Paris (France). AN UNSUPERVISED CLASSIFICATION OF MULTISPECTRAL SCANNER DATA USING CORRESPONDENCE ANALYSIS (CLAMS)**

J-M. Monget and P. Roux *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B

Jun. 1975 p 1237-1244 refs

**(I-9) CSCL 05B**

An unsupervised classification method was designed as a three step procedure: dimension reduction, classification of channels and clustering of measured reflectance spectra. The basic concept is that similar channels are most likely to characterize typical shapes of reflectance spectrum. Some results are shown which are in good agreement with the known ground truth. Author

**N76-17534\*** Environmental Research Inst. of Michigan, Ann Arbor.

**ADVANCES IN AUTOMATIC EXTRACTION OF EARTH RESOURCES INFORMATION FROM MULTISPECTRAL SCANNER DATA**

John D. Erickson *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 1245-1274 refs

(Contracts NAS9-14123; NAS1-13128; NAS1-11979)

**(I-10) CSCL 05B**

The basis of spectral discrimination was briefly examined indicating sources of variability which tend to obscure the spectral attributes of the classes of interest. Spatial and temporal discrimination bases are also discussed. Automatic processing functions, techniques and methods, and equipment are discussed with emphasis on techniques and equipment required for operational large area surveys with satellite data. Techniques for carrying out major functions of preprocessing for signature extension, feature extraction, discrimination, display, and applications modeling were examined. A multiplicative and additive signature correction technique and a proportion estimation technique are discussed. The development of the multivariate interactive digital analysis system multispectral processor system which represents a breakthrough in cost effective high throughput processing for large area surveys from satellites and aircraft is reviewed. Applications and results are discussed briefly for agricultural crop inventories, environmental monitoring, and resources surveys from ERIM LANDSAT and EREP investigations to indicate the substantial progress achieved to date. Author

**N76-17535\*** General Electric Co., Beltsville, Md. Space Systems Dept.

**IMAGE 100: THE INTERACTIVE MULTISPECTRAL IMAGE PROCESSING SYSTEM**

Earle S. Schaller and Robert W. Towles *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 1275-1291

**(I-11) CSCL 14E**

The need for rapid, cost-effective extraction of useful information from vast quantities of multispectral imagery available from aircraft or spacecraft has resulted in the design, implementation and application of a state-of-the-art processing system known as IMAGE 100. Operating on the general principle that all objects or materials possess unique spectral characteristics or signatures, the system uses this signature uniqueness to identify similar features in an image by simultaneously analyzing signatures in multiple frequency bands. Pseudo-colors, or themes, are assigned to features having identical spectral characteristics. These themes are displayed on a color CRT, and may be recorded on tape, film, or other media. The system was designed to incorporate key features such as interactive operation, user-oriented displays and controls, and rapid-response machine processing. Owing to these features, the user can readily control and/or modify the analysis process based on his knowledge of the input imagery. Effective use can be made of conventional photographic interpretation skills and state-of-the-art machine analysis techniques in the extraction of useful information from multispectral imagery. This approach results in highly accurate multitheme classification of imagery in seconds or minutes rather than the hours often involved in processing using other means. Author

**N76-17541\*** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

## 07 DATA PROCESSING AND DISTRIBUTION SYSTEMS

### ERIPS: EARTH RESOURCE INTERACTIVE PROCESSING SYSTEM

Matthew J. Quinn *In its* NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 1351-1353 ref

#### (I-17) CSCL 05B

The ERIPS is an interactive computer system used in the analysis of remotely sensed data. It consists of a set of software programs which are executed on an IBM System/360 Model 75J computer under the direction of a trained analyst. The software was a derivative of the Purdue LARSYS program and has evolved to include an extensive pattern recognition system and a number of manipulative, preprocessing routines which prepare the imagery for the pattern recognition application. The original purpose of the system was to analyze remotely sensed data, to develop and perfect techniques to process the data, and to determine the feasibility of applying the data to significant earth resources problems. The System developed into a production system. Error recovery and multi-jobbing capabilities were added to the system. Author

**N76-17542\*** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

### LOW-COST DATA ANALYSIS SYSTEMS FOR PROCESSING MULTISPECTRAL SCANNER DATA

Sidney L. Whitley *In its* NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 1355-1375 refs

#### (I-18) CSCL 05B

A research-oriented data analysis system was developed which is used for evaluating complex remote sensor systems and for development of techniques for application of remotely sensed data. Some modular hardware components were developed which may be added to one's existing facilities to establish a low-cost data analysis system for processing multispectral scanner data. Software modules which are compatible with small general purpose digital computers process and analyze remote sensor data, and convert it to information needed by users. The software modules are written in FORTRAN IV language for ease of transfer to other computer systems. The basic hardware and software system requirements are defined for some low-cost data analysis systems consisting of an image display system, a small general purpose digital computer, and an output recording device. The hardware modules consist of: a LANDSAT MSS data reformatting program; a series of spectral pattern recognition programs required to generate surface classification maps and tabular information; programs to convert computer generated maps from image space to a geographically referenced base; programs to extract data and irregularly shaped areas and to produce thematic maps of the designated areas; and programs to tabulate acreages of selected classification categories. Some off-the-shelf, inexpensive digital image display systems are described. Author

### N76-17544\* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena. DESIGN CRITERIA FOR A MULTIPLE INPUT LAND USE SYSTEM

Frederic C. Billingsley and Nevin A. Bryant *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 1389-1396 refs

#### (I-20) CSCL 08B

A design is presented that proposes the use of digital image processing techniques to interface existing geocoded data sets and information management systems with thematic maps and remote sensed imagery. The basic premise is that geocoded data sets can be referenced to a raster scan that is equivalent to a grid cell data set, and that images taken of thematic maps or from remote sensing platforms can be converted to a raster scan. A major advantage of the raster format is that x, y coordinates are implicitly recognized by their position in the scan, and z values can be treated as Boolean layers in a three-dimensional data space. Such a system permits the rapid incorporation of data sets, rapid comparison of data sets, and adaptation to variable scales by resampling the raster scans. Author

**N76-17547\*** ESL, Inc., Sunnyvale, Calif.

### INTERACTIVE DIGITAL IMAGE MANIPULATION SYSTEM

Janice Henze and Robert DeZur *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 1415-1435 refs

#### (I-23) CSCL 05B

The system is designed for manipulation, analysis, interpretation, and processing of a wide variety of image data. LANDSAT (ERTS) and other data in digital form can be input directly into the system. Photographic prints and transparencies are first converted to digital form with an on-line high-resolution microdensitometer. The system is implemented on a Hewlett-Packard 3000 computer with 128 K bytes of core memory and a 47.5 megabyte disk. It includes a true color display monitor, with processing memories, graphics overlays, and a movable cursor. Image data formats are flexible so that there is no restriction to a given set of remote sensors. Conversion between data types is available to provide a basis for comparison of the various data. Multispectral data is fully supported, and there is no restriction on the number of dimensions. In this way multispectral data collected at more than one point in time may simply be treated as a data collected with twice (three times, etc.) the number of sensors. There are various libraries of functions available to the user: processing functions, display functions, system functions, and earth resources applications functions. Author

**N76-17548\*** Stanford Research Inst., Menlo Park, Calif.

### IMAGE ANIMATION FOR THEME ENHANCEMENT AND CHANGE DETECTION

Wm. E. Evans *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1976 p 1437-1450 refs

#### (I-24) CSCL 14E

Animated displays are useful in enhancing subtle temporally related changes in scenes viewed by satellites capable of providing repetitive coverage. The detectability of fixed features is also improved through the help of the powerful visual integration process. To expedite the process of assembling and displaying well-registered, time-lapse sequences and to provide means for making quantitative measurements of radiances, displacements, and areas, an electronic satellite image analysis console was constructed. During the LANDSAT-1 program, this equipment was applied to the needs of a number of earth resource investigators with interests principally related to dynamic hydrology. The measurement of the areal extent of snow cover within defined drainage basins is discussed as a representative applications example. Author

**N76-17551\*** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany).

### SENSOR EQUIPMENT OF THE GERMAN EARTH SCIENTIFIC AIRPLANE PROGRAM

Peter Seige *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 1483-1497

#### (I-27) CSCL 14B

The German airplane program for earth scientific research supports the work of a vast staff of earth scientists from universities and federal agencies. Due to their fields of interest, which are in oceanography, hydrology, geology, ecology, and forestry, five test areas were selected which are spread all over Germany. The sensor package, which was designed in accordance with the requirements of this group of scientists, will be installed in a DO 28 D2 type airplane. The sensor equipment consists of a series of 70-mm cameras having different film/filter combinations, a photogrammetric camera, an infrared radiometer, an 11-channel multispectral line scanner, a LANDSAT-compatible radiometer, and a complex avionic system. Along with the airplane, a truck will be equipped with a set of radiometers and other sensor devices for extensive ground-truth measurement; this also includes a cherry picker. Author

**N76-17554\*** Georgia Dept. of Natural Resources, Atlanta.

### AN EXAMINATION OF THE POTENTIAL APPLICATIONS

# OF AUTOMATIC CLASSIFICATION TECHNIQUES TO GEORGIA MANAGEMENT PROBLEMS

Bruce Q. Rado /In NASA. Lyndon B. Johnson Space Center  
NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975  
p 1525-1540 refs  
(L-2) CSCL 05A

Automatic classification techniques are described in relation to future information and natural resource planning systems with emphasis on application to Georgia resource management problems. The concept, design, and purpose of Georgia's statewide Resource AS Assessment Program is reviewed along with participation in a workshop at the Earth Resources Laboratory. Potential areas of application discussed include: agriculture, forestry, water resources, environmental planning, and geology.

J.M.S.

# N76-17574\* Battelle Columbus Labs., Ohio. THE SIGNIFICANCE OF THE SKYLAB ALTIMETER EXPERIMENT RESULTS AND POTENTIAL APPLICATIONS

A. G. Mourad, S. Gopalapillai, and M. Kuhner /In NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975 p 1887-1909 refs

(M-1) CSCL 05B

The Skylab Altimeter Experiment has proven the capability of the altimeter for measurement of sea surface topography. The geometric determination of the geoid/mean sea level from satellite altimetry is a new approach having significant applications in many disciplines including geodesy and oceanography. A Generalized Least Squares Collocation Technique was developed for determination of the geoid from altimetry data. The technique solves for the altimetry geoid and determines one bias term for the combined effect of sea state, orbit, tides, geoid, and instrument error using sparse ground truth data. The influence of errors in orbit and a priori geoid values are discussed. Although the Skylab altimeter instrument accuracy is about + or - 1 m, significant results were obtained in identification of large geoidal features such as over the Puerto Rico trench. Comparison of the results of several passes shows that good agreement exists between the general slopes of the altimeter geoid and the ground truth, and that the altimeter appears to be capable of providing more details than are now available with best known geoids. The altimetry geoidal profiles show excellent correlations with bathymetry and gravity. Potential applications of altimetry results to geodesy, oceanography, and geophysics are discussed. Author

# N76-17582\* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md. LANDSAT DIGITAL DATA PROCESSING: A NEAR REAL-TIME APPLICATION

John L. Barker, Charles Bohn, Locke Stuart, and John Hill (Texas A/M Univ., College Station) /In its NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975 p 2063-2073

(M-9) CSCL 05B

An application of rapid generation of classed digital images from LANDSAT-1 was demonstrated and its feasibility evaluated by NASA in conjunction with the Environmental Protection Agency (EPA), Texas A and M University (TAMU), and the Cousteau Society. The primary purpose was to show that satellite data could be processed and transmitted to the Calypso, which was used as a research vessel, in time for use in directing it to specific locations of possible plankton upwellings, sediment, or other anomalies in the coastal water areas along the Gulf of Mexico.

Author

# N76-17584\* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

QUANTITATIVE SUSPENDED SEDIMENT MAPPING USING AIRCRAFT REMOTELY SENSED MULTISPECTRAL DATA  
Robert W. Johnson /In its NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975 p 2087-2098 refs

(M-11) CSCL 08B

Suspended sediment is an important environmental parameter for monitoring water quality, water movement, and land use. Quantitative suspended sediment determinations were made from analysis of aircraft remotely sensed multispectral digital data. A statistical analysis and derived regression equation were used to determine and plot quantitative suspended sediment concentration contours in the tidal James River, Virginia, on May 28, 1974. From the analysis, a single band, Band 8 (0.70-0.74 microns), was adequate for determining suspended sediment concentrations. A correlation coefficient of 0.89 was obtained with a mean inaccuracy of 23.5 percent for suspended sediment concentrations up to about 50 mg/l. Other water quality parameters - secchi disc depth and chlorophyll - also had high correlations with the remotely sensed data. Particle size distribution had only a fair correlation with the remotely sensed data.

Author

# N76-17586\* National Aeronautics and Space Administration. Earth Resources Labs., Bay St. Louis, Miss.

## AUTOMATIC INTERFACE MEASUREMENT AND ANALYSIS

Kenneth H. Faller /In its NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975 p 2127-2146 refs

(M-13) CSCL 05B

A technique for detecting and measuring the interface between two categories in classified scanner data is described together with two application demonstrations. Measurements were found to be accurate to 1.5% root mean square error on features of known length while comparison of measurements made using the technique on LANDSAT data to opisometer measurements on 1:24,000 scale maps shows excellent agreement. Application of the technique to two frames of LANDSAT data classified using a two channel, two class classifier resulted in a computation of 64 km annual decrease in shoreline length. The tidal shoreline of a portion of Alabama was measured using LANDSAT data. Based on the measurement of this portion, the total tidal shoreline length of Alabama is estimated to be 1313 kilometers. Author

# N76-17622# Lockheed Missiles and Space Co., Palo Alto, Calif. ON THE QUESTION OF ESTIMATING THE INFORMABILITY OF PHOTOGRAPHS RECEIVED FROM SATELLITES

N. B. Trapeznikova [1975] 6 p refs Transl. into ENGLISH from Tr. Gidrometeorolog. Nauchno-Issled. Tsentr. SSSR, Sputnikovaia Meteorol. (USSR), no. 148, 1974 p 66-72  
Avail: NTIS HC \$3.50; National Translation Center, John Crerar Library, Chicago, Illinois 60616

Procedures for selecting the most appropriate scan photograph for the best information possible are discussed. Data cover comparisons of images of different scales in the same spectrum and in different spectrum bands, recognizing characteristics of the object being studied, satellite scanning altitude and scanning angle of optical system used, and resolution of the apparatus in which the minimum size of the objects seen in the photograph depends. It was also concluded that type of photographic film and film processing procedures, quality of reproducible brightness gradients, and performance of ground receivers affect image quality.

E.H.W.

# N76-17626 World Meteorological Organization, Geneva (Switzerland).

## COLLECTION, PROCESSING AND PUBLICATION OF DATA

In its Guide to Hydrol. Pract. 1974 35 p refs

Copyright.

The observational procedures, transmission of hydrological observations, quality control and storage and cataloging of data collected for hydrological purposes are considered. As an example the computation and quality control of streamflow data is described. General methods of data processing are discussed together with the requirements for special applications such as runoff, soil moisture, snow and ice cover. The need for publication of the data is discussed with attention paid to frequency and formats as well as hydrological requirements.

ESA

## 07 DATA PROCESSING AND DISTRIBUTION SYSTEMS

**N76-17634** Institut Geographique National, Paris (France).  
**FILMS FOR PHOTOGRAMMETRIC CAMERA [FILMS POUR CHAMBRE METRIQUE]**

Michel Osche and Guy Ducher *In its Appl. of Photogrammetric Cameras and Sensors for Earth Survey Mission Using Spacelab* 14 May 1975 9 p In FRENCH

(GRED/GD/116)

Available film thicknesses are reviewed and discussed in view of use with the Spacelab photogrammetric camera. The amount of film required for complete stereoscopic coverage of western Europe is discussed with regard to magazine capability (250 views) and camera focal length. The constraint of flight duration is detailed leading to an optimal strategy, taking into account orbital drift. Film stock onboard is dealt with considering temperature, humidity and radiation protection. ESA

**N76-17704#** National Oceanic and Atmospheric Administration, Boulder, Colo. Space Environment Lab.

**A COMPUTER PROCESSING METHOD FOR REAL-TIME MAGNETOMETER OBSERVATIONS**

Larry J. Gardner and Charles E. Hornback May 1975 8 p refs

(COM-75-11403/3; NOAA-TM-ERL-SEL-40; NOAA-75091806)  
Avail: NTIS HC \$3.50 CSCL 08N

A computer method that has been developed for estimating the K-indices and gamma deviations of a ground-based magnetometer is discussed. The results give automated, real-time observations that are suitable for operational applications. GRA

**N76-17840#** Army Engineer Topographic Labs., Fort Belvoir, Va.

**TEXTURE TONE STUDY: SUMMARY AND EVALUATION**

Technical Report, May 1970 - Sep. 1974

R. J. Orsinger Mar. 1975 40 p refs

(DA Proj. 4A7-52707-A-854)

(AD-A015540; ETL-0006) Avail: NTIS CSCL 09/2

This report summarizes and evaluates the work performed on the Texture Tone Study, which was a study developing a statistical model using the texture-tone information contained in digital images to extract military geographic information from the corresponding aerial images. After some introductory comments, this report describes various data sets used in the study, addresses the need for and the method of quantizing the digital images, and documents the task of selecting quantitative expressions or textural features that characterizes the various texture-tone categories in the study. In addition, a section of this report is devoted to the classification schemes used by the Contractor, to a description of a linear programming model, and to the display capability that was developed on the University of Kansas' Image Discrimination, Enhancement and Combination System (IDECS) and a PDP-15/20 computer configuration. GRA

**N76-18414#** Joint Publications Research Service, Arlington, Va.

**INSTRUMENTS FOR GRAVITY DETERMINATION AT SEA AND THEIR ANALYSIS**

Yu. D. Bulanzhe, ed. 19 Feb. 1976 109 p refs Transl. into ENGLISH from the book "Pribory dlya Opredeleniya Sily Tyazhesti na More i ikh Issledovaniye" Moscow, Izd. Nauka, 1966 p 1-160

(JPRS-66815) Avail: NTIS HC \$5.50

The first automated Soviet marine gravimeter, the GAL-TsPAV, is briefly described. The results of its laboratory and ship studies are included. Author

**N76-18589#** Tri-State Regional Planning Commission, New York.

**INVESTIGATION OF SATELLITE IMAGERY FOR REGIONAL PLANNING Final Report, 1972 - 1974**

William Harting, Principal Investigator Aug. 1975 72 p ERTS (Contract NAS5-21738)

(E76-10168; NASA-CR-146369) Avail: NTIS HC \$4.50 CSCL 08B

The author has identified the following significant results. Satellite multispectral imagery was found to be useful in regional planning for depicting general developed land patterns, wooded areas, and newly constructed highways by using visual photointerpretation methods. Other characteristics, such as residential and nonresidential development, street patterns, development density, and some vacant land components cannot be adequately detected using these standard methods.

**N76-18598#** Geological Survey, Reston, Va.  
**OVERALL EVALUATION OF SKYLAB (EREP) IMAGES FOR CARTOGRAPHIC APPLICATION Final Report**

Alden P. Colvocoresses, Principal Investigator 15 Dec. 1975 22 p refs EREP

(NASA Order T-5395-B)

(E76-10177; NASA-CR-147423) Avail: NTIS HC \$3.50 CSCL 08B

**N76-18600#** Colorado School of Mines, Golden. Dept. of Geology.

**EVALUATION OF SKYLAB S190-A PHOTOS FOR ROCK DISCRIMINATION AND COMPARISON WITH ERTS IMAGERY**

Kennan Lee, Principal Investigator and Daniel H. Knepper Dec. 1975 29 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 EREP

(Contract NAS9-13394)

(E76-10179; NASA-CR-146378; Rept-75-4) Avail: NTIS HC \$4.00 CSCL 08G

**N76-18603#** Instituto de Pesquisas Espaciais, Sao Paulo (Brazil).  
**SOME RESULTS ON THE USE OF THE LANDSAT-1 MULTISPECTRAL IMAGES**

Rene A. Novaes, Principal Investigator 28 May 1975 12 p Presented at the Earth Resources Survey Symp., Houston Sponsored by NASA ERTS

(E76-10182; NASA-CR-146381; INPE-659-RRE/006) Avail: NTIS HC \$3.50 CSCL 08F

**N76-18607#** Environmental Research Inst. of Michigan, Ann Arbor. Infrared and Optics Div.

**SKYLAB REMOTE BATHYMETRY EXPERIMENT Final Report**

Fabian C. Polcyn and David R. Lyzenga Jan. 1976 64 p refs Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 EREP

(Contract NAS9-13278)

(E76-10186; NASA-CR-144482; ERIM-102100-21-F) Avail: NTIS HC \$4.50 CSCL 08J

**N76-18616#** Earth Satellite Corp., Berkeley, Calif.  
**THE USEFULNESS OF SKYLAB/EREP S-190 AND S-192 IMAGERY IN MULTISTAGE FOREST SURVEYS Final Report**

Philip G. Langley and Jan VanRoessel, Principal Investigators Jan. 1976 134 p refs Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue Sioux Falls, S. D. 57198 EREP

(Contract NAS9-13289)

(E76-10197; NASA-CR-147439; G-091) Avail: NTIS HC \$6.00 CSCL 02F

The author has identified the following significant results. The RMSE of point location achieved with the annotation system on S190A imagery was 100 m and 90 m in the x and y direction, respectively. Potential gains in sampling precision attributable to space derived imagery ranged from 4.9 to 43.3 percent depending on the image type, interpretation method, time of year, and sampling method applied. Seasonal variation

was significant. S190A products obtained in September yielded higher gains than those obtained in June. Using 100 primary sample units as a base under simple random sampling, the revenue made available for incorporating space acquired data into the sample design to estimate timber volume was as high as \$39,400.00.

**N76-18620\*#** Department of the Environment, Ottawa (Ontario).  
**USE OF SATELLITES IN DATA RETRANSMISSION**

R. A. Halliday, Principal Investigator Nov. 1975 23 p refs  
Sponsored by NASA ERTS  
(E76-10208; NASA-CR-146301) Avail: NTIS HC \$3.50 CSCL 17B

**N76-18627\*#** Lockheed Electronics Co., Houston, Tex. Dept.  
of Life Sciences Applications.

**AN INTERACTIVE METHOD FOR DIGITIZING ZONE MAPS**

L. E. Giddings and Everett J. Thompson Sep. 1975 43 p  
(Contract NAS9-12200)  
(NASA-CR-147466; JSC-09809; LEC-6498) Avail: NTIS HC \$4.00 CSCL 08B

A method is presented for digitizing maps that consist of zones, such as contour or climatic zone maps. A color-coded map is prepared by any convenient process. The map is then read into memory of an Image 100 computer by means of its table scanner, using colored filters. Zones are separated and stored in themes, using standard classification procedures. Thematic data are written on magnetic tape and these data, appropriately coded, are combined to make a digitized image on tape. Step-by-step procedures are given for digitization of crop moisture index maps with this procedure. In addition, a complete example of the digitization of a climatic zone map is given. Author

**N76-18634\*#** National Aeronautics and Space Administration.  
Goddard Space Flight Center, Greenbelt, Md.

**LANDSAT US STANDARD CATALOG, 1-31 DECEMBER 1975**

31 Dec. 1975 106 p  
(NASA-TM-X-72959; GSFC/U-40) Avail: NTIS HC \$5.50 CSCL 05B

Information regarding the availability of LANDSAT imagery processed and input to the data files by the NASA Data Processing Facility is published on a monthly basis. The U.S. Standard Catalog includes imagery covering the continental United States, Alaska and Hawaii. The Non-U.S. Standard Catalog identifies all the remaining coverage. Sections 1 and 2 describe the contents and format for the catalogs and the associated microfilm. Section 3 provides a cross-reference defining the beginning and ending dates for LANDSAT cycles. Sections 4 and 5 cover LANDSAT-1 and LANDSAT-2 coverage, respectively. Author

**N76-18636\*#** National Aeronautics and Space Administration.  
Goddard Space Flight Center, Greenbelt, Md.

**LANDSAT NON-US STANDARD CATALOG, 1-31 DECEMBER 1975**

31 Dec. 1975 104 p  
(NASA-TM-X-72960; GFSC/N-40) Avail: NTIS HC \$5.50 CSCL 05B

The Non-U.S. Standard Catalog lists Non-U.S. imagery acquired by LANDSAT 1 and 2 which has been processed and input to the data files during the referenced month. Data, such as date acquired, cloud cover and image quality are given for each scene. The microfilm roll and frame on which the scene may be found is also given. Author

**N76-18637#** Naval Weapons Center, China Lake, Calif.  
**RECORDING AND PROCESSING OF THERMOVISION DATA**

Barry L. Thompson Aug. 1975 13 p  
(AD-A016254; NWC-TP-5778) Avail: NTIS CSCL 14/3

Improved techniques have been developed for the analog recording of AGA Thermovision data using commercially available tape recorders. Linear and nonlinear recording and reproduction of the video signal from the pre-amplifier yield a record of the instrument's output with little loss in accuracy, resolution, and dynamic range. When this raw video signal is subsequently reproduced and inserted into the Thermovision monitor, all of the processing functions in the monitor can be used for reduction and analysis of the data. A crosshair generator adapted to a Thermovision format can be used to indicate the aim point of an infrared tracker on an infrared image of the target in the same spectral band. GRA

**N76-18725\*#** National Aeronautics and Space Administration.  
Marshall Space Flight Center, Huntsville, Ala.

**A STUDY OF A SECTOR SPECTROPHOTOMETER AND AURORAL O+(2P-2D) EMISSIONS**

Gary R. Swenson Washington Jan. 1976 191 p refs  
(NASA-TN-D-8143) Avail: NTIS HC \$7.50 CSCL 04A

The metastable O+(2P-2D) auroral emission was investigated. The neighboring OH contaminants and low intensity levels of the emission itself necessitated the evolution of an instrument capable of separating the emission from the contaminants and having a high sensitivity in the wavelength region of interest. A new type of scanning photometer was developed and its properties are discussed. The theoretical aspects of auroral electron interaction with atomic oxygen and the resultant O+(2P-2D) emissions were examined in conjunction with N2(+)1NEG emissions. Ground based measurements of O+(2P-2D) auroral emission intensities were made using the spatial scanning photometer (sector spectrophotometer). Simultaneous measurements of N2(+)1NEG sub 1.0 emission intensity were made in the same field of view using a tilting photometer. Time histories of the ratio of these two emissions made in the magnetic zenith during auroral breakup periods are given. Theories of I sub 7319/I sub 4278 of previous investigators were presented. A rocket measurement of N2(+)1NEG sub 0.0 and O+(2P-2D) emission in aurora was examined in detail and was found to agree with the ground based measurements. Theoretical examination resulted in the deduction of the electron impact efficiency generating O+(2P) and also suggests a large source of O+(2P) at low altitude. A possible source is charge exchange of N+(1S) with OI(3P). Author

**N76-19182\*#** National Aeronautics and Space Administration.  
Lyndon B. Johnson Space Center, Houston, Tex.

**REFURBISHMENT OF THE CRYOGENIC COOLERS FOR THE SKYLAB EARTH RESOURCES EXPERIMENT PACKAGE**

Jerry C. Smithson and Norman C. Luksa In its 9th Aerospace Mech. Symp. Aug. 1975 p 133-148 ref

CSCL 14B

SkyLab Earth Resources Experiment Package (EREP) experiments, S191 and S192, required a cold temperature reference for operation of a spectrometer. This cold temperature reference was provided by a subminiature Stirling cycle cooler. However, the failure of the cooler to pass the qualification test made it necessary for additional cooler development, refurbishment, and qualification. A description of the failures and the cause of these failures for each of the coolers is presented. The solutions to the various failure modes are discussed along with problems which arose during the refurbishment program. The rationale and results of various tests are presented. The successful completion of the cryogenic cooler refurbishment program resulted in four of these coolers being flown on Skylab. The system operation during the flight is presented. Author

**N76-19535\*#** National Aeronautics and Space Administration.  
Goddard Space Flight Center, Greenbelt, Md.

**LANDSAT: US STANDARD CATALOG, 1-31 JANUARY 1976**

31 Jan. 1976 146 p

## 07 DATA PROCESSING AND DISTRIBUTION SYSTEMS

(NASA-TM-X-72992; GSFC/LU-76/001;

NTISUB/B/138-76/001) Avail: NTIS HC \$6.00 CSCL 05B

Information regarding the availability of LANDSAT imagery processed and input to the data files by the NASA Data Processing Facility is published on a monthly basis. The U.S. Standard Catalog includes imagery covering the continental United States, Alaska and Hawaii. The Non-U.S. Standard Catalog identifies all the remaining coverage. Section 1 and 2 describe the contents and format for the catalogs and the associated microfilm. Section 3 provides a cross-reference defining the beginning and ending dates for LANDSAT cycles. Sections 4 and 5 cover LANDSAT-1 and LANDSAT-2 coverage, respectively. Author

**N76-19536\*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

**LANDSAT: NON-US STANDARD CATALOG, 1-31 JANUARY 1976**

31 Jan. 1976 153 p

(NASA-TM-X-72991; GSFC/LN-76/001) Avail: NTIS HC \$6.75 CSCL 05B

Information regarding the availability of LANDSAT imagery processed and input to the data files by the NASA Data Processing Facility is published on a monthly basis. The U.S. Standard Catalog includes imagery covering the continental United States, Alaska and Hawaii. The Non-U.S. Standard Catalog identifies all the remaining coverage. Sections 1 and 2 describe the contents and format for the catalogs and the associated microfilm. Section 3 provides a cross-reference defining the beginning and ending dates for LANDSAT cycles. Author

**N76-19538\*#** TRW Systems Group, Redondo Beach, Calif. **EARTH RESOURCES MISSION PERFORMANCE STUDIES. VOLUME 2: SIMULATION RESULTS Final Report, 8 May - 2 Aug. 1974**

2 Aug. 1974 69 p 2 Vol.

(Contract NAS9-14117)

(NASA-CR-147411; TRW-25651-6002-TU-00-Vol-2) Avail: NTIS HC \$4.50 CSCL 05B

Simulations were made at three month intervals to investigate the EOS mission performance over the four seasons of the year. The basic objectives of the study were: (1) to evaluate the ability of an EOS type system to meet a representative set of specific collection requirements, and (2) to understand the capabilities and limitations of the EOS that influence the system's ability to satisfy certain collection objectives. Although the results were obtained from a consideration of a two sensor EOS system, the analysis can be applied to any remote sensing system having similar optical and operational characteristics. While the category related results are applicable only to the specified requirement configuration, the results relating to general capability and limitations of the sensors can be applied in extrapolating to other U.S. based EOS collection requirements. The TRW general purpose mission simulator and analytic techniques discussed in this report can be applied to a wide range of collection and planning problems of earth orbiting imaging systems. Author

**N76-19662#** Southeastern Massachusetts Univ., North Dartmouth. Dept. of Electrical Engineering.

**PATTERN ANALYSIS AND CLASSIFICATION WITH THE NEW ACDA SEISMIC SIGNATURE DATA BASE Interim Report**

C. H. Chen and I. Chang Lin 12 Aug. 1975 110 p refs

(Grant AF-AFOSR-2119-71; AF Proj. 9769)

(AD-A015925; AFOSR-75-1296TR) Avail: NTIS CSCL 08/11

The new and expanded ACDA seismic data base makes it possible for meaningful comparison of different seismic recognition techniques based on the same data set. There are 157 earthquake and 157 explosion records in the data base. Pattern analysis in frequency domain as well as two-dimensional space is performed to seek for classification clues. Although useful structure of the seismic records is not available, the mathematical features provided by the autocorrelation function have 86.36% correct recognition on testing set by using 3 features (autocorrelation coefficients), 80 selected good quality training samples per class

and the nearest-neighbor decision rule. All samples in the training set are identified correctly and thus the overall recognition rate of 93.00% is achieved. This result is better than the 89.2% recognition using dynamic spectral ratios (Table 7). The autocorrelation coefficients which are simple to calculate also perform better than the linear predictor (Markel) coefficients and other discriminants. GRA

**N76-19669** Georgia Univ., Athens.

**ESTIMATION OF 1-HOUR TIMELAG FUEL MOISTURE WITH SURFACE AND SYNCHRONOUS METEOROLOGICAL SATELLITE DATA Ph.D. Thesis**

Marshall Pope Waters, III 1975 176 p

Avail: Univ. Microfilms Order No. 76-6457.

Synchronous meteorological satellite visual and infrared spin scan radiometer data were analyzed quantitatively for cloud cover and surface temperature for an area in the southeastern United States for 5 days in January 1975. Surface measures of air temperature and humidity at National Weather Service and military observation stations within the study area augmented the satellite data. The 1-hour timelag fuel moisture component of fuel model D in the National Fire Danger Rating System was estimated by: (1) using the satellite visual information for cloud cover, (2) air temperature blended with surface equivalent black body temperatures, and (3) an estimate of humidity made from ground stations. This automated estimate of 1-hour timelag fuel moisture was compared with measured values taken at Fire Danger Stations located in the study area. Dissert. Abstr.

**N76-19828#** Army Engineer Topographic Labs., Fort Belvoir, Va. Technology Development Branch.

**ANALOG GRAPHIC PROCESSING FOR 3-D TERRAIN DISPLAYS, PROFILES, AND ELEVATION LAYER TINTS Research Note, Mar. - Apr. 1975**

L. P. Murphy and E. G. Trelinskie, Jr. Oct. 1975 29 p refs (DA Proj. 4A7-62707-A-854)

(AD-A017493; ETL-0026) Avail: NTIS CSCL 09/2

This report briefly describes a computerized technique for transforming digital elevation data into gray-level-encoded film. This film is then used for near-real-time analog graphic (nondigital) processing for the display of terrain perspectives, profiles, and elevation layer tints. This report concludes that this approach offers considerable potential, at base and/or field levels, for producing special map graphics, displays, and analyzing terrain conditions for line-of-sight problems or nap-of-the-earth flight plans. Author (GRA)

**N76-20596\*#** Ohio Dept. of Economic and Community Development, Columbus.

**DEVELOPMENT OF A MULTI-DISCIPLINARY ERTS USER PROGRAM IN THE STATE OF OHIO Quarterly Progress Report**

Paul E. Baldrige, Principal Investigator 10 Sep. 1975 2 p ERTS

(Contract NAS5-22399)

(E76-10249; NASA-CR-146623) Avail: NTIS HC \$3.50 CSCL 05B

**N76-20607\*#** California Univ., Berkeley. Space Science Lab. **DIGITAL HANDLING AND PROCESSING OF REMOTE SENSING DATA Final Report, Jul. 1972 - Jul. 1973**

Robert N. Colwell, V. Ralph Algazi, Principal Investigators, D. J. Sakrison, J. Schrieberman, W. Dere, B. Romberger, and A. Samulon 1974 89 p refs Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS (Contract NAS5-21827)

(E76-10262; NASA-CR-146634; SSL-SER-16-Issue-66;

Rept-5-21827(ERTS)) Avail: NTIS HC \$5.00 CSCL 05B

The author has identified the following significant results. A systematic approach to the enhancement of images was developed. This approach exploits two principal features involved

in the observation of images: the properties of human vision and the statistics of the images being observed. The stripping effect is greatly magnified as images are enhanced digitally for visibility in the water; the range of useful sensor outputs is then quite narrow and errors are more significant. It is possible to bring about some improvement on image quality by equalizing the sensors response based on statistics of the received data.

**N76-20615#** DBA Systems, Inc., Melbourne, Fla.  
**THE COMBINATION OF GRAVITY AND SATELLITE ALTIMETRY DATA FOR DETERMINING THE GEOID SURFACE** Final Report, Nov. 1974 - Aug. 1975

Georges Blaha Aug. 1975 116 p refs  
 (Contract F19628-75-C-0069)  
 (AD-A015828; AFCRL-TR-75-0347) Avail: NTIS CSCL 08/5

A recent report by Brown (1973) initiated a new approach to satellite altimetry adjustment, in the sense that highly accurate reference orbits are no longer required. Computer simulations indicated that in this way, global oceanic geoid accurate to within 1 to 2 meters rms may be determined from the reduction of GEOS-C satellite observations. However, worthwhile geoidal accuracies cannot be obtained over land masses from the reduction of satellite altimetry alone. GRA

**N76-21243\*#** Lockheed Electronics Co., Houston, Tex. Aero-space Systems Div.

**SATELLITES FOR LIFE SCIENCES**

L. E. Giddings Jan. 1976 65 p refs  
 (Contract NAS9-12200)  
 (NASA-CR-144475; LEC-7737; JSC-10856) Avail: NTIS HC \$4.50 CSCL 22B

The potential of all available satellites for adaptation of earth resources technology to life science problems is summarized. Author.

**N76-21254\*#** Smithsonian Astrophysical Observatory, Cambridge, Mass.

**SATELLITE-TRACKING AND EARTH-DYNAMICS RESEARCH PROGRAMS** Semiannual Progress Report, 1 Jul. - 31 Dec. 1974

31 Dec. 1974 70 p refs  
 (Grant NGR-09-015-002)  
 (NASA-CR-146811; SAPR-31) Avail: NTIS HC \$4.50 CSCL 22C

Observations and research progress of the Smithsonian Astrophysical Observatory are reported. Satellite tracking networks (ground stations) are discussed and equipment (Baker-Nunn cameras) used to observe the satellites is described. The improvement of the accuracy of a laser ranging system of the ground stations is discussed. Also, research efforts in satellite geodesy (tides, gravity anomalies, plate tectonics) is discussed. The use of data processing for geophysical data is examined, and a data base for the Earth and Ocean Physics Applications Program is proposed. Analytical models of the earth's motion (computerized simulation) are described and the computation (numerical integration and algorithms) of satellite orbits affected by the earth's albedo, using computer techniques, is also considered. Research efforts in the study of the atmosphere are examined: (the effect of drag on satellite motion), and models of the atmosphere based on satellite data are described. J.R.T.

**N76-21622\*+** National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.  
**LANDSAT: US STANDARD CATALOG, 1-29 FEBRUARY 1976**

29 Feb. 1976 135 p  
 (NASA-TM-X-73047; GSFC/LU-76/002) Avail: NTIS HC \$5.00 CSCL 05B

The U.S. Standard Catalog lists U.S. imagery acquired by LANDSAT 1 and LANDSAT 2 which has been processed and input to the data files during the referenced month. Data, such as date acquired, cloud cover and image quality are given for

each scene. The microfilm roll and frame on which the scene may be found is also given. Author

**N76-21623\*+** National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

**LANDSAT: NON-US STANDARD CATALOG, 1-29 FEBRUARY 1976**

29 Feb. 1976 110 p  
 (NASA-TM-X-73048; GSFC/LN-76/002; NTISUB/B/139-76/002) Avail: NTIS HC \$5.00 CSCL 05B

Information regarding the availability of LANDSAT imagery processed and input to the data files by the NASA Data Processing Facility is published on a monthly basis. The U.S. Standard Catalog includes imagery covering the continental United States, Alaska and Hawaii. The non-U.S. Standard Catalog identifies all the remaining coverage. Sections 1 and 2 describe the contents and format for the catalogs and the associated microfilm. Section 3 provides a cross-reference defining the beginning and ending dates for LANDSAT cycles. Sections 4 and 5 cover LANDSAT-1 and LANDSAT-2 coverage, respectively. Author

**N76-21665\*#** Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.

**COMPUTER CLASSIFICATION OF REMOTELY SENSED MULTISPECTRAL IMAGE DATA BY EXTRACTION AND CLASSIFICATION OF HOMOGENEOUS OBJECTS**

R. L. Kettig 1975 194 p refs  
 (Contract NAS9-14016)  
 (NASA-CR-147403; LARS-IN-050975) Avail: NTIS HC \$7.50 CSCL 05B

A method of classification of digitized multispectral images is developed and experimentally evaluated on actual earth resources data collected by aircraft and satellite. The method is designed to exploit the characteristic dependence between adjacent states of nature that is neglected by the more conventional simple-symmetric decision rule. Thus contextual information is incorporated into the classification scheme. The principle reason for doing this is to improve the accuracy of the classification. For general types of dependence this would generally require more computation per resolution element than the simple-symmetric classifier. But when the dependence occurs in the form of redundancy, the elements can be classified collectively, in groups, thereby reducing the number of classifications required. Author

**N76-21816#** Army Electronics Command, Fort Monmouth, N.J.  
**EMPIRICAL INVESTIGATION OF THREE ITERATIVE METHODS FOR INVERTING THE RADIATIVE TRANSFER EQUATION**

Elton P. Avara and George Alexander Oct. 1975 32 p refs  
 (DA Proj. 1T1-62111-AH-71)  
 (AD-A017730; ECOM-5576) Avail: NTIS CSCL 04/1

Three iterative methods for inverting the integral form of the radiative transfer equation to obtain temperature profiles from satellite infrared radiance measurements were subjected to a detailed empirical investigation. The methods are (a) minimum information method, (b) Smith's direct method, and (c) Duncan's modification of Smith's direct method. Each method was examined for (a) rate of convergence, (b) frequency response to differences between the first guess temperature profile and the true temperature profile, and (c) the effects of noise on the radiance measurements. Details of the investigation and the results are presented in the report. GRA

**N76-21860#** Naval Research Lab., Washington, D.C.  
**OCEAN SCIENCES DIVISION: RECENT DEVELOPMENTS IN INSTRUMENTATION AND TECHNIQUES** Final Report  
 Richard Nekritz Nov. 1975 26 p  
 (AD-A018133; NRL-MR-3150) Avail: NTIS CSCL 08/3

Since 1966, when the Ocean Sciences Division originated, its scientists have developed a variety of instruments and techniques to apply to their studies of marine chemistry, air-sea interactions, air-mass trajectories, fog generation, pollution, and



## 07 DATA PROCESSING AND DISTRIBUTION SYSTEMS

ocean turbulence. This report describes several of these developments, some of which may be applicable to the scientific or technical problems of other investigators. Author (GRA)

## INSTRUMENTATION AND SENSORS

Includes data acquisition and camera systems and remote sensors.

**A76-18905** Combined sequential analysis of multiple features. J. D. Nichols and W. M. Senkus (California, University, Berkeley, Calif.). In: Symposium on Machine Processing of Remotely Sensed Data, 2nd, West Lafayette, Ind., June 3-5, 1975, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 1A-28 to 1A-30.

A method for the computerized sequential analysis of multiple-feature remote sensing data is described. The method called OWNMASK utilizes previous classification results to control new classifications. The preparatory data consists of a previous classification (masked or unmasked), multifeature digital data which must overlay the result of the previous classifications (the mask), and one or more sets of training statistics describing all the new classes to be found in the data. The method is applied to the analysis of juniper wood inventory data sensed by the Landsat-1 multispectral-band scanner. B.J.

**A76-18914** Digital processing of infra-red scanner data for radiometric temperature analysis of thermal plumes. D. Langner, J. Michael, and D. Wright (EG & G, Inc., Los Alamos, N. Mex.). In: Symposium on Machine Processing of Remotely Sensed Data, 2nd, West Lafayette, Ind., June 3-5, 1975, Proceedings.

New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 2B-1 to 2B-8. Contract No. AT(29-1)-1183.

A method for digitally reducing thermal plume data obtained from a Bendix Thermal Mapper is presented. This method includes a distortion removal technique and the calculation of apparent blackbody temperature from the scanner's output film. This method is illustrated using data obtained with a Bendix scanner over the Surry Station nuclear power generating facility located on the James River in Surry, Virginia. (Author)

**A76-18917** Digital image reconstruction and resampling for geometric manipulation. K. W. Simon (TRW Systems Group, Redondo Beach, Calif.). In: Symposium on Machine Processing of Remotely Sensed Data, 2nd, West Lafayette, Ind., June 3-5, 1975, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 3A-1 to 3A-11. 6 refs.

Digital image registration and geometric correction can be divided into two parts: (1) determination of the warping function which will transform the geometry of the scene to the desired coordinate system, and (2) processing of the digital image intensity samples on the desired coordinate grid, which process is called resampling. This paper defines the process of resampling in terms of general image system models, and the requirements of digital image geometric manipulation. The problem is formulated as a constrained linear estimation problem. The various resampling techniques are compared against Landsat MSS data. B.J.

**A76-18918 \*** Exploiting the temporal coherence of repetitive satellite imagery. W. E. Evans (Stanford Research Institute, Menlo Park, Calif.). In: Symposium on Machine Processing of Remotely Sensed Data, 2nd, West Lafayette, Ind., June 3-5, 1975, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 3A-12 to 3A-20. Contract No. NAS5-21841.

Imagery from ERTS or the Synchronous Meteorological Satellites, because of its precisely repetitive nature, is ideally suited both for subjective enhancement by time-lapse display and for objective measurements of changes with time. A hybrid system providing both

viewing and image-processing functions is described. A representative application involves the measurement of changes in the aerial extent of snow cover within specified mountain watersheds. Subjective viewing of time-lapse sequences of the snow scenes provides valuable insight into the nature of numerous extraneous signals, permitting the interim implementation of operationally useful snow-measuring systems and hopefully leading toward the design of fully objective classifiers. (Author)

**A76-18927 \*** Machine aided multispectral analysis utilizing Skylab thermal data for land use mapping. L. L. Biehl and L. F. Silva (Purdue University, West Lafayette, Ind.). In: Symposium on Machine Processing of Remotely Sensed Data, 2nd, West Lafayette, Ind., June 3-5, 1975, Proceedings. New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 4B-3 to 4B-12. 9 refs. Contract No. NAS9-13301.

Skylab eight channel multispectral scanner data obtained in January 1974, was used for land-use analysis of Allen County, Indiana. The data-set which includes one visible channel, four near infrared channels, two middle infrared channels, and one far infrared channel was from the X-5 detector array of the S-192 experiment in the Earth Resources Experiment Package on board Skylab. The results indicate that a good-quality far infrared (thermal) channel is very valuable for land use mapping during the winter months. (Author)

**A76-19081** Interpretation of radiation measurements on 'meteor' satellites, and the basis for conversion from the albedo of the ocean-atmosphere system to the shortwave radiation at the ocean surface. N. A. Timofeev (Akademiia Nauk Ukrainskoi SSR, Morskoi Gidrofizicheskii Institut, Moscow, USSR). (*Akademiia Nauk SSSR, Izvestiia, Fizika Atmosfery i Okeana*, vol. 11, Jan. 1975, p. 15-26.) *Academy of Sciences, USSR, Izvestiya, Atmospheric and Oceanic Physics*, vol. 11, Aug. 1975, p. 8-14. 20 refs. Translation.

**A76-19134** International Society of Photogrammetry, Symposium, Stuttgart: Universität, Stuttgart, West Germany, September 2-6, 1974, Proceedings. Munich, Verlag der Bayerischen Akademie der Wissenschaften (Deutsche Geodätische Kommission, Reihe B - Angewandte Geodäsie, No. 214), 1975. 363 p.

Papers are devoted to block adjustment methods for aerial photographs, aerial triangulation, bundle adjustment and systematic error analysis performed on aerial images, photogrammetric calibration methods, and the use of interpolation for treating topographic images. Particular attention is paid to radar remote sensing with emphasis on side-looking radar imagery. Geometric problems in side-looking radar, the radargrammetric point determination project in Colombia, a flight simulation system for geometric radar restitution, and the analysis of digital multispectral scanner data are discussed. B.J.

**A76-19135** Approach and status of geometric restitution for remote sensing imagery. G. Konecny. In: International Society of Photogrammetry, Symposium, Stuttgart Universität, Stuttgart, West Germany, September 2-6, 1974, Proceedings. München, Verlag der Bayerischen Akademie der Wissenschaften, 1975, p. 188-198. 18 refs.

The paper discusses progress made by the working group, 'Geometry of Remote Sensing' whose emphasis is on nonclassical remote sensors, particularly radar mapping and satellite scanning. The process of geometric restitution consists of analytical analysis, mapping, image gridding, differential rectification, and automatic image correlation. A table is presented listing sensor parameters, including film size, resolution lines, angular view, and scale factors. Another table lists the remote sensing tools, including aerial photography, television, scanners (MSS, thermal, and microwave), radar and sonar. B.J.

**A76-19139** Deformations of SLAR imagery - Results from actual surveys. H. Jensen. In: International Society of Photogrammetry, Symposium, Stuttgart Universität, Stuttgart, West Germany, September 2-6, 1974, Proceedings. Munich, Verlag der Bayerischen Akademie der Wissenschaften, 1975, p. 230-234.

The paper investigates the scale and position errors of an airborne side-looking radar imagery system for remote sensing. The most prominent image deformation are discussed, including those caused by system errors, noise and resolution limits. The effects of these errors on the quality of imagery of a hypothetical square figure whose axis is parallel to the flight surface, in a hypothetical level surface at ground level are studied. Errors due to flight path curvature, vertical oscillations, data processing, and aircraft guidance are considered. The possibility of good slant range-ground range correction to provide an almost perfect balance of scale is discussed, and it is shown that distortions arising from cyclical variations can be corrected in the correlation process. B.J.

**A76-19140** Interpolation and filtering of ERTS imagery. H. P. Bähr. In: International Society of Photogrammetry, Symposium, Stuttgart Universität, Stuttgart, West Germany, September 2-6, 1974, Proceedings. Munich, Verlag der Bayerischen Akademie der Wissenschaften, 1975, p. 235-243.

Least-squares filtering and interpolation is applied to an ERTS frame in multispectral scanner channels 5 and 7. Covariance functions are determined from the residual errors of 4-parameter fit. Though there is only a small number of reference points, results come out well. Results from least-squares interpolation are compared with residual errors from second-order polynomial interpolation. (Author)

**A76-19141** Topographic accuracy of side-looking radar imagery. E. E. Derenyi. In: International Society of Photogrammetry, Symposium, Stuttgart Universität, Stuttgart, West Germany, September 2-6, 1974, Proceedings. Munich, Verlag der Bayerischen Akademie der Wissenschaften, 1975, p. 244-250.

The topographic accuracy of two strips of airborne SLAR imagery, taken over Phoenix, Arizona, at a scale of 1:400,000 was investigated. Linear conformal-, affine-, and polynomial transformations were employed to test the planimetric accuracy of determining position and elevation points. The best results obtained for the root mean square error were 27.4 m. The method was also used for the adjustment of heights. (Author)

**A76-19142** Analysis of digital multispectral scanner (MSS) data. E. M. Mikhail, J. R. Baker, and G. W. Marks. In: International Society of Photogrammetry, Symposium, Stuttgart Universität, Stuttgart, West Germany, September 2-6, 1974, Proceedings. Munich, Verlag der Bayerischen Akademie der Wissenschaften, 1975, p. 251-258.

Single (nonoverlapping) digital MSS data is processed using both parametric and nonparametric techniques. Parametric methods are based on the collinearity equations and the application of polynomials to express the behavior of the sensor exterior orientation elements. The resulting expressions may include the object point elevations if they are externally available. Nonparametric procedures considered include: the arithmetic mean, the moving average, the meshwise linear transformation and linear least-squares filtering. The specific characteristics involved in the reduction of digital data, are discussed. (Author)

**A76-19143** Space Oblique Mercator - A new map projection of the earth. A. P. Colvocoresses. In: International Society of Photogrammetry, Symposium, Stuttgart Universität, Stuttgart, West Germany, September 2-6, 1974, Proceedings. Munich, Verlag der Bayerischen Akademie der Wissenschaften, 1975, p. 259-265. 10 refs.

The Earth Resources Technology Satellite (ERTS) Multispectral Scanner (MSS) is producing imagery of great geometric fidelity. The

positional errors (rms) of points on a properly controlled image are less than the 80-meter instantaneous field of view (picture element) of the scanner. Such accuracy is attributed to the stability of the scanner and spacecraft and to the corrections made before each image is printed. The image is formed on a cylindrical surface in space which can be defined as a specific map projection which results in the mapping of the earth (between the 82 deg parallels) every 18 days. The projection is mathematically definable and thus has the potential of developing into an automated mapping system in which the picture element (pixel) can be discretely related to its position on the figure of the earth. (Author)

**A76-19144** Geometric calibration of Canadian ERTS photoreproduction system. V. Kratky. In: International Society of Photogrammetry, Symposium, Stuttgart Universität, Stuttgart, West Germany, September 2-6, 1974, Proceedings. Munich, Verlag der Bayerischen Akademie der Wissenschaften, 1975, p. 266-272. 6 refs.

Two photoreproduction instruments used in the Canadian production of ERTS photographs were experimentally tested to determine the magnitude and character of geometric image distortions caused by the reproduction process. A suitable analytical formulation, based on the results, was found, and used for the system calibration. (Author)

**A76-19178 \*** Performance modeling of earth resources remote sensors. R. H. Kidd and R. H. Wolfe (IBM Corp., Federal Systems Div., Houston, Tex.). *IBM Journal of Research and Development*, vol. 20, Jan. 1976, p. 29-39. 22 refs. Contract No. NAS9-14350.

A technique is presented for constructing a mathematical model of an earth resources remote sensor. The technique combines established models of electronic and optical components with formulated models of scan and vibration effects, and it includes a model of the radiation effects of the earth's atmosphere. The resulting composite model is useful for predicting in-flight sensor performance, and a descriptive set of performance parameters is derived in terms of the model. A method is outlined for validating the model for each sensor of interest. The validation for one airborne infrared scanning system is accomplished in part by a satisfactory comparison of predicted response with laboratory data for that sensor. (Author)

**A76-19262** Future developments in remote sensing (Zukünftige Entwicklung der Fernerkundung). P. Hartl (Berlin, Technische Universität, Berlin, West Germany). (*Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, 7th, Kiel, West Germany, Sept. 17-19, 1974.*) In: Deutsche Gesellschaft für Luft- und Raumfahrt, Yearbook 1974. Cologne, Deutsche Gesellschaft für Luft- und Raumfahrt, 1975, p. 212-227. 19 refs. In German.

Plans related to the continuation of the ERTS program are considered and a description concerning the development and the objectives of the 2000-kg earth observatory satellite is given. Aspects of data reception are discussed along with approaches for overcoming difficulties in the study of objects with time-varying observational characteristics. Such approaches are to make use of satellites in geostationary or other orbits especially adapted to the study objective. Attention is given to special purpose satellites, satellites designed in particular for the study of the surface of the sea, Nimbus G, GEOS-C, the laser geodynamic satellite, the satellite Geopase, EOPAP, Spacelab, and questions of microwave technology. G.R.

**A76-19266 \*** Texture measurements for the automatic classification of imagery. L. Kirvada (Honeywell, Inc., Systems and Research Div., Minneapolis, Minn.). *IEEE Transactions on Electromagnetic Compatibility*, vol. EMC-18, Feb. 1976, p. 38-42. 10 refs. Contract No. NAS5-21866.

The stated purpose is to demonstrate the applicability of texture measurements for making distinctions between classes of imagery. Multispectral images obtained from aircraft and satellites have been successfully delineated into land use classes on the basis of density in the different spectral bands. However, spatial patterns can add additional information to improve classification accuracy. A comparison is made between the results obtained using five texture algorithms for separating land use classes using ERTS imagery. The transforms evaluated are the Karhunen-Loeve, the fast Fourier, the Walsh-Hadamard, the Slant, and a digital matched filter. (Author)

**A76-19692 # Theory of spatial-temporal gridding of satellite-survey results (K teorii prostranstvenno-vremennoi priviazki rezul'tatov kosmicheskikh s'emyok).** I. I. Krasnorylov and M. S. Urmaev (Moskovskii Institut Inzhenerov Geodezii Aerofotos'emki i Kartografii, Moscow, USSR). *Geodeziia i Aerofotos'emka*, no. 2, 1975, p. 91-101. 7 refs. In Russian.

Several aspects of spatial-temporal gridding of satellite surveys on to a map are considered for the general formulation of the problem. It is noted that the solution is based on the use of photographs of the earth's surface and the celestial sphere, obtained synchronously with 'earth' and 'star' cameras, of which the elements of mutual orientation are known. Algorithms are presented which determine, when two photographs overlap, the orientation of the space chord joining two points on the earth's surface and of the orbital chords joining two successive positions of a satellite at two times when photographs are taken. It is shown that the coordinates of the centers where the photographs are taken can be determined by integrating the differential equations of the satellite motions. Necessary conditions for performing this integration are outlined.

F.G.M.

**A76-19695 # Analytical method for photogrammetric processing of a single radar photograph (Analiticheskii metod fotogrammetricheskoi obrabotki odinochnogo radiolokatsionnogo snimka).** Iu. N. Korneev. *Geodeziia i Aerofotos'emka*, no. 2, 1975, p. 115-124. In Russian.

An analytical method is described for determining the coordinates of objects in a locality from a single photograph obtained with side-looking radar. Mathematical proof of the method's validity is presented. The possibility is demonstrated of using this method when five reference points or less are involved. Results are given for computer tests of the method on a simulated photograph. F.G.M.

**A76-20996 A retrospective on earth-resource surveys - Arguments about technology, analysis, politics, and bureaucracy.** A. H. Katz (U.S. Arms Control and Disarmament Agency, Washington, D.C.). *Photogrammetric Engineering and Remote Sensing*, vol. 42, Feb. 1976, p. 189-199. 17 refs.

**A76-20997 \* Utilization of remote sensing data - The sociological perspective.** I. R. Hoos (California, University, Berkeley, Calif.). *Photogrammetric Engineering and Remote Sensing*, vol. 42, Feb. 1976, p. 201-210. 32 refs. Grant No. NGL-05-003-404.

Remote sensing provides an opportunity to study the ways in which new sources of data enter into decisions related to resource management, the conditions and criteria for acceptance of the new techniques, and the methods by which assessment of their utility is accomplished. This article underscores the social dimensions of technology utilization and assessment, with reliability, specificity, ease of access, and openness among the main desiderata. The point is made that the interface between the technology and the society it is designed to serve is crucial, for upon its nature depend how, whether, when, and by whom the technology will be utilized. The present reliance on quantitative techniques, such as benefit-cost analyses, is reviewed from a sociological view point, and the inadequacy of these techniques is pointed out. (Author)

**A76-21000 \* Shutter/aperture settings for aerial photography.** H. E. Lockwood and L. Perry (Technicolor Graphic Services, Inc., Houston, Tex.). *Photogrammetric Engineering and Remote Sensing*, vol. 42, Feb. 1976, p. 239-249. 7 refs. Contract No. NAS9-11500.

Determination of aerial camera shutter and aperture settings to produce consistently high-quality aerial photographs is a task complicated by numerous variables. Presented in this article are brief discussions of each variable and specific data which may be used for the systematic control of each. The variables discussed include sunlight, aircraft altitude, subject and season, film speed, and optical system. Data which may be used as a base reference are included, and encompass two sets of sensitometric specifications for two film-chemistry processes along with camera-aircraft parameters, which have been established and used to produce good exposures. Information contained here may be used to design and implement an exposure-determination system for aerial photography. (Author)

**A76-21785 \* Use of satellite imagery to delineate soil associations in the Sand Hills region of Nebraska.** D. T. Lewis; J. V. Drew (Nebraska, University, Lincoln, Neb.), and P. M. Seevers. *Soil Science Society of America, Proceedings*, vol. 39, Mar.-Apr. 1975, p. 330-335. 16 refs. Contract No. NAS5-21765.

**A76-21816 Photogrammetric image evaluation techniques.** R. Welch (Georgia, University, Athens, Ga.). (*International Society for Photogrammetry, Symposium on Remote Sensing and Aerial Photography, Stockholm, Sweden, Aug. 27-29, 1974.*) *Photogrammetria*, vol. 31, Nov. 1975, p. 161-190. 62 refs.

Modern image evaluation techniques are reviewed in relation to photogrammetric and cartographic tasks. Particular attention is given to modulation transfer function analysis techniques which, in recent years, have evolved from the theoretical/experimental stage into demonstrably useful procedures. Methods of estimating system resolving power from MTF and edge data, and the reliability of predicting and deriving MTFs for operational aircraft and satellite (Landsat, Skylab) imagery are discussed. Also described are procedures for: (1) photographic quality control; (2) analyzing degradations occurring in the cartographic reproduction process; and (3) estimating the precision and accuracy of photogrammetric measurements. This review indicates that quantitative procedures with a high degree of flexibility are now available to the photogrammetrist to determine the suitability of imagery for mapping or resource inventory applications. (Author)

**A76-22221 # Inertial navigation as a scientific tool.** N. W. Emmott (Litton Systems /Canada/, Ltd., Rexdale, Ontario, Canada). (*Canadian Symposium on Navigation and Resources Management, 1st, Ottawa, Canada, Nov. 13, 1974.*) *Canadian Aeronautics and Space Journal*, vol. 21, Oct. 1975, p. 302-304.

Inertial navigation, because it is automatic, self-contained, and has a powerful computing capability, is highly suitable for scientific and exploratory work. Its accurate outputs of attitude and heading, and also velocity and position in analog and digital form, make it a valuable adjunct to other air-borne scientific instruments. (Author)

**A76-22641 Sensitivity investigation of Fourier Transforms for the inversion of microwave radiometric measurements.** J. J. Holmes, C. A. Balanis, and W. M. Truman (West Virginia University, Morgantown, W. Va.). In: *Electricity: An expanding technology; Proceedings of the Southeast Region 3 Conference, Charlotte, N.C., April 6-9, 1975. Volume 2.* New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 5C-2-1 to 5C-2-5. 10 refs.

Remote sensing of the ocean surface's absolute brightness temperature is possible with the present microwave radiometer technology. To extract the brightness temperature of the water from the antenna temperature equation, an unstable Fredholm integral equation of the first kind is solved. The instability of the Fredholm equation is demonstrated and a restoration procedure is included

which smooths the resulting oscillations. Actual radiometric measurements of sea water are inverted using the restoration method, incorporating the advantages of the Fast Fourier Transform algorithm for computations. (Author)

**A76-22649** Application of horizon sensing and comparison to low-flying aircraft navigation. G. E. Carlson, G. L. Bair, and C. M. Benoit (Missouri, University, Rolla, Mo.). In: *Electricity: An expanding technology; Proceedings of the Southeast Region 3 Conference*, Charlotte, N.C., April 6-9, 1975. Volume 2.

New York, Institute of Electrical and Electronics Engineers, Inc., 1975, p. 6E-1.1 to 6E-1.9. Contract No. N00014-69-A-0141-0009. NR Project 387-076.

A technique for using on-board sensed horizon profiles and stored reference horizon profiles to provide navigation information for low-flying aircraft is described. Results of a feasibility study which was performed using digitized terrain data and computer simulations to obtain system performance comparisons and tradeoffs are shown. (Author)

**A76-23577 #** Shortwave spectrophotometer for field measurements. A. S. Britaev (Central High Altitude Hydrometeorological Observatory, Moscow, USSR). (*Polska Akademia Nauk, Seminarium Ozonu*, 4th, Belsk, Poland, July 8, 1974.) *Polska Akademia Nauk, Instytut Geofizyki, Materiały i Prace*, vol. 90, 1975, p. 5-11.

The paper describes a spectrophotometer that can be used for ozone measurements and recording of atmospheric absorption in the 250-580 nm range. It consists of a quartz double monochromator with 33 nm/division resolution, a radiation source directing device, neutral calibrated attenuators, scanning device, amplifier, recorder, and power supply. Some ozone measurements are presented which show good agreement with those obtained by a Dobson ozone spectrophotometer. P.T.H.

**A76-23677 #** The selection of site-resolution and site-acquisition for the photographic equipment of the operative system of a spacecraft on the basis of user requirements. (O vybore razresheniia i zakhvata na mestnosti s'emochnoi apparatury operativnoi kosmicheskoi sistemy na osnove trebovaniia potrebiteliei). Iu. L. Biriukov and T. D. Sazhina (Akademiiia Nauk SSSR, Institut Kosmicheskikh Issledovani, Moscow, USSR). *Geodeziia i Aerofotos'emka*, no. 1, 1975, p. 35-39. In Russian.

**A76-23678 #** Questions relating to the preparation of photography of the earth surface from spacecraft (Voprosy proektirovaniia s'emki poverkhnosti zemli s kosmicheskikh korablei). N. D. Nazarov (Tsentral'nyi Nauchno-Issledovatel'skii Institut Geodezii, Aeos'emki i Kartografii, Moscow, USSR). *Geodeziia i Aerofotos'emka*, no. 1, 1975, p. 41-50. In Russian.

Satellite-borne photography must take account of certain parameters of spacecraft motion including orbital parameters, flight velocity, complex maneuvers, etc. This paper deals with the preparation of photographic equipment in order to compensate for the effects of satellite motion. The satellite is assumed to be following an elliptical orbit with small eccentricity, a small distance from the earth. For the preparation, it is necessary to know the satellite position at a given moment of time and the location of the orbital path on the map. For the sake of simplification, a procedure is introduced to transform the elliptical orbit in question into a circular orbit. B.J.

**A76-23680 #** Cosmic photogrammetry for geological surveys (Kosmicheskaiia fotogrammetriia dlia geologicheskikh issledovani). G. B. Gonin (Ministerstvo Geologii SSSR, Laboratoriia Aerometodov, USSR). *Geodeziia i Aerofotos'emka*, no. 1, 1975, p. 55-62. 11 refs. In Russian.

Several problems relating to the photogrammetry of satellite-

borne photography of the earth surface, taken in the framework of geological surveys, are discussed. These problems include the selection of coordinate systems and the determination of relationships among systems for different types of satellite orientation and stabilization; evaluation of the distortion of the coordinates of images of the earth surface due to satellite motion, meteorological factors, and instrument errors; determination of the elements of external reference; the creation of a theory of transformation; and the realization of photomaps. B.J.

**A76-23682 #** An attempt to solve the problem of photogrammetric resection using spaceborne photographs (Opyt resheniia obratnoi fotogrammetricheskoi zasedchki po kosmicheskim fotosnimkam). G. B. Gonin, E. M. Grishchuk, and L. N. Shustova (Ministerstvo Geologii SSSR, Laboratoriia Aerometodov, USSR). *Geodeziia i Aerofotos'emka*, no. 1, 1975, p. 67-77. 8 refs. In Russian.

A method developed by Lobanov (1967, 1972) for solving the problem of photogrammetric resection (resection is a method of orientation on a map by drawing lines through the plotted positions of two or more objects to locate the coordinates of the position in question) is applied to satellite-borne geological surveying. It is a successive approximation method consisting of several cycles. The first cycle compares the measured two-dimensional coordinates with those calculated from the external reference elements (photomaps). The difference between coordinates for each landmark, delta x, delta y, is recorded, along with the root-mean-square value sigma of the quantity delta S equals the square root of delta x squared plus delta y squared. The second cycle processes those landmarks for which the difference in coordinates surpasses some given value. The successive approximation cycle continues until there is observed for all the landmarks a criterion of double root-mean-square deviation, 2 sigma. B.J.

**A76-23684 #** The use of quasi-photographs in strip phototriangulation (Primenenie kvazisnimkov v marshrutnoi fototriangulatsii). A. G. Chibunichov (Moskovskii Institut Inzhenerov Geodezii, Aerofotos'emki i Kartografii, Moscow, USSR). *Geodeziia i Aerofotos'emka*, no. 1, 1975, p. 89-92. In Russian.

Quasi-photographs are used to generalize aerial-photographic information and to construct phototriangulation grids of large extent. Quasi-photographs are a given (central, for example) projection of a model of an object constructed from several or many real photographs. They can be obtained from independent partially overlapping models constructed from separate stereopairs and also from the model of the entire aerial strip or segment of the strip. The construction of a phototriangulation grid on the basis of quasi-photographs consists of the following steps: (1) construction of a triangulation plan; (2) measurement of coordinates on the real photographs; (3) construction of independent models from the real photographs; (4) creation of quasi-photographs from the independent models; and (5) the phototriangulation from the quasi-photographs. B.J.

**A76-24001** Effective utilization and application of small-format camera systems; *Proceedings of the Seminar, Anaheim, Calif., March 17, 18, 1975*. Seminar sponsored by the Society of Photo-Optical Instrumentation Engineers. Edited by F. R. LaGesse (McDonnell Douglas Corp., St. Louis, Mo.). Palos Verdes Estates, Calif., Society of Photo-Optical Instrumentation Engineers (SPIE Proceedings. Volume 58), 1975. 220 p. \$32.

The state-of-the-art of small-format camera systems is examined, and numerous new pieces of equipment and their applications are described. The major design considerations for small-format camera systems are also set forth. Some of the topics covered include a 3-inch miniature panoramic camera, films for small-format aerial photography, laser scanning camera, the small-format camera for tactical reconnaissance, the Super-8 reticle recording camera, limitations in miniature tactical camera design, and component integration in the miniature camera.

**A76-24003** Small format photography for mini-RPV. C. Orlando (U.S. Army, Electronics Command, Fort Monmouth, N.J.). In: Effective utilization and application of small-format camera systems; Proceedings of the Seminar, Anaheim, Calif., March 17, 18, 1975. Palos Verdes Estates, Calif., Society of Photo-Optical Instrumentation Engineers, 1975, p. 15-20.

Studies have been carried out to develop a basic design concept for a camera system to be used with radio-guided drones in aerial surveillance missions. A panoramic camera concept making use of a 35-mm format was selected for further development. Flight tests and computer analyses indicate that a simple camera system with a single fast shutter speed of 1/2000 sec and a single high aperture setting of  $f/1.4$  will provide acceptable photographs over a significant part of the day. An experimental developing formulation, POTA, makes it possible to overexpose a negative by 7 stops and still obtain usable imagery, eliminating the need for automatic aperture control. C.K.D.

**A76-24013** Photogrammetric potentials of small-format camera systems. H. M. Karara (Illinois, University, Urbana, Ill.). In: Effective utilization and application of small-format camera systems; Proceedings of the Seminar, Anaheim, Calif., March 17, 18, 1975. Palos Verdes Estates, Calif., Society of Photo-Optical Instrumentation Engineers, 1975, p. 104-110, 10 refs.

Photogrammetric potentials of nonmetric cameras are reviewed, with particular reference to the results achieved with small-format (70 mm and 35 mm) camera systems used in several projects and to data-reduction procedures and techniques employed. A discussion of the advantages and disadvantages of nonmetric cameras with respect to metric cameras indicates that while the use of nonmetric cameras solves the problem of focusing, it introduces a number of serious problems that have to be carefully considered. Applications of close-range photogrammetry with small-format cameras include automobile speed determination, estimation of orientation of cleats (cleavage planes) in coal mines, and determination of the geometry of aortic heart valves. It is shown that in several engineering and scientific areas of application of close-range photogrammetry, the accuracy achievable through the use of small-format cameras and suitable analytical data reduction techniques is completely satisfactory. S.D.

**A76-24053** Measurement of the sea wave spectrum by aerial photography (Mesure du spectre de la houle par photographie aérienne). B. de Lagarde (Société Bertin et Cie., Plaisir, Yvelines, France) and E. de Bazelaire (Toulon, Centre Universitaire, France). (Association Technique Maritime et Aéronautique, Session, 75th, Paris, France, May 12-16, 1975.) Association Technique Maritime et Aéronautique, Bulletin, no. 75, 1975, p. 239-255; Discussion, p. 256-260. In French.

It is shown that one aerial photograph of the sea surface contains potentially all the information needed to determine the directional energy spectrum of the sea. This information is optically processed in coherent light, making it possible to obtain the Fourier transform of the function in two variables  $z$  equals  $f(x,y)$  which is representative of the sea surface. In the Fourier plane, each component of the sea waves appears in the form of a luminous spot. The azimuth of the spot indicates the direction of propagation; the distance of the spot from the center is proportional to the spatial frequency; the intensity of the spot is a function of the energy of the component. P.T.H.

**A76-25066** Remote sensing as a system. I (Il remote sensing come sistema. I). L. G. Napolitano (Napoli, Università, Naples, Italy). L'Aerotecnica - Missili e Spazio, vol. 54, Oct.-Dec. 1975, p. 292-318. 10 refs. In Italian.

The paper presents a systems analysis of remote sensing, giving a characterization of the main subsystems data acquisition and transmission, data reception and preprocessing, data processing, data analysis, and utilization of information obtained. The author describes the basic types of available sensors, platforms, transmission

systems, ancillary subsystems, control operations, data conversion systems, recording systems, data storage, reproduction and distribution techniques, and methods for presenting information for immediate or later use. P.T.H.

**A76-25115** Landsat - Multispectral eye in the sky. J. J. Horan (General Electric Co., Space Div., Valley Forge, Pa.). IEEE Spectrum, vol. 13, Mar. 1976, p. 59-62.

The instrumentation, data processing system, and applications of the Landsat (Earth Resources Technology Satellite) system are discussed. The system comprises two identical satellites in sun-synchronous orbits. Each carries two major remote sensors, a return beam vidicon camera (RBV), and a multispectral scanner (MSS). The RBV consists of three television cameras operating in different spectral regions and collecting data on a period of milliseconds. The MSS scans the ground continuously on a line-to-line basis. The data are processed to yield images which are corrected and scaled to a universal transverse Mercator projection. The Landsat system has been used for high-speed mapping and for detection of sedimentation from organic pollutants in bodies of water. C.K.D.

**A76-25399** Space photography and geological exploration (Kosmicheskaia fotos'emka i geologicheskie issledovaniia). Edited by G. B. Gonin and S. I. Strel'nikov. Leningrad, Izdatel'stvo Nedra, 1975, 416 p. In Russian.

Theoretical and practical questions of space photography, space photogrammetry, and geological interpretation of space photographs are examined in detail. The characteristics of obtaining daytime pictures of the earth's surface from spacecraft are considered under the aspect of spacecraft orientation and laws of motion of celestial mechanics. Special attention is given to the effect of the atmosphere on photograph quality. Space photogrammetry is studied by setting forth a method of strict photogrammetric resection of space photographs, and the transformation of photographs and the drawing up of maps of a given projection on their basis. Principles of geological interpretation of space photos are set forth, with special emphasis on lithologic-petrographic complexes and geomorphological structure. P.T.H.

**A76-25496 \*** Evaluation of Skylab data for land use mapping. L. L. Biehl and L. F. Silva (Purdue University, West Lafayette, Ind.). Journal of the Astronautical Sciences, vol. 23, Apr.-June 1975, p. 121-146. 7 refs. Contract No. NAS9-13301.

Skylab multispectral scanner data, digitized Skylab color IR photography, digitized Skylab black and white multiband photography, and Earth Resources Technology Satellite (ERTS) multispectral scanner data collected within a twenty-four hour time period over an area in south-central Indiana near Bloomington on June 9 and 10, 1973, were compared in a machine-aided land use analysis of the area. The overall classification performance results, obtained with nine land use classes were 87% correct classification using the 'best' 4 channels of the Skylab multispectral scanner, 80% for the channels on the Skylab multispectra scanner, which are spectrally comparable to the ERTS multispectral scanner, 88% for the ERTS multispectral scanner, 83% for the digitized color IR photography, and 76% for the digitized black and white multiband photography. The results indicate that the Skylab multispectral scanner may yield even higher classification accuracies when a noise filtered multispectral scanner data set becomes available in the near future. (Author)

**A76-26547 #** On the accuracy of aerophotogrammetric open-pit surveying. K. Dressler (VEB, Kombinat Schwarze Pumpe, Hoyerswerda, East Germany). Jena Review, vol. 21, no. 2, 1976, p. 74-76. 5 refs.

**A76-26548 #** Aerial colour photographs help compile the utilization plan of a recreation area. A. Reinhold (Eberswalde

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Institute of Forest Sciences, Eberswalde, East Germany) and M. Succow (Eberswalde Institute of Soil Science, Eberswalde, East Germany). *Jena Review*, vol. 21, no. 2, 1976, p. 77-81.

Aerial color photographs of a region near Frankfort in the German Democratic Republic were obtained in connection with plans to utilize this region as a recreation area. The pictures obtained included near-vertical photographs taken on Orwocolor UT 18 film without an ultraviolet absorbing filter. The photographs were evaluated in stages by the integral method. Details of photograph interpretation are discussed, taking into account the conditions of the lake located within the recreation area. G.R.

**A76-27271 \*** Selective radiant temperature mapping using a layered classifier. L. A. Bartolucci, P. H. Swain (Purdue University, West Lafayette, Ind.), and C. Wu (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.). *IEEE Transactions on Geoscience Electronics*, vol. GE-14, Apr. 1976, p. 101-106. Grant No. NGL-15-005-186; Contract No. NAS5-21773.

A method of measuring temperatures of selected ground-cover types using remotely sensed multispectral scanner data and a layered classification approach is described. A brief review of radiation theory is presented to show that for the wavelength bands and temperature ranges involved in remote sensing applications, a linear calibration function can be satisfactorily utilized. An example of the application of the layered classifier for temperature mapping of water is shown. (Author)

**A76-27978** Aerial reconnaissance and photogrammetry with small cameras. W. E. Woodcock (Aerial Survey, Inc., Miles City, Mont.). *Photogrammetric Engineering and Remote Sensing*, vol. 42, Apr. 1976, p. 503-511. 7 refs.

A method is described whereby 35- and 70-mm cameras, a new film, a simple lightweight mount, and a minimally modified light aircraft can be used to achieve large camera results, inexpensively, in the acquisition of black-and-white aerial reconnaissance photography. (Author)

**A76-28051** Remote sensing of earth resources. Volume 4 - Proceedings of the Fourth Annual Conference on Earth Resources, University of Tennessee, Tullahoma, Tenn., March 24-26, 1975. Conference sponsored by the University of Tennessee. Edited by F. Shahrokhi (Tennessee, University, Tullahoma, Tenn.). Tullahoma, University of Tennessee, 1975. 824 p. \$30.

The geomorphic interpretation of Skylab photography collected over the Nevada portion of the Great Basin, the use of infrared imagery in the selection of a port facility in western Australia, the application of Landsat to rangeland management, to a wetlands inventory of Nebraska, to soil mapping of northwestern India and to snow and vegetation classification are considered. Also examined are the use of remote sensors for the early detection of Dutch elm disease, for the detection of Gypsy Moth damage, for air and water pollution measurements, for thermal pollution monitoring, for ground water prospecting in Tennessee, for sediment mapping and for determining Kansas water quality. Attention is also paid to the application of information theory to remote sensing, the organization of a computer-based integrated resource inventory, mapping and assessment system based on Landsat data, the description of a German program for aerial remote sensing, a computer-based remote sensing literature cataloging system and the digital correction of Landsat multispectral scanner bulk data for high resolution image data base.

B.J.

**A76-28054** Information theory applied to remote sensing. E. L. Maxwell (Colorado State University, Fort Collins, Colo.). In: Remote sensing of earth resources. Volume 4 - Proceedings of the Fourth Annual Conference on Earth Resources, Tullahoma, Tenn.,

March 24-26, 1975.

Tullahoma, University of

Tennessee, 1975, p. 43-67. 6 refs.

Following a brief introduction to information theory, the capacity of human beings for discriminating between categories of various kinds of sensory stimuli is found to be surprisingly low (about 2.3 bits or 5 categories). Evidence that this capacity can be increased by 1 bit for each perceptual anchor provided suggests ways of improving the performance of photo-interpreters. An analysis of multivariate systems points the way to a better understanding of results obtained from multispectral images. In particular, the loss of information due to correlation between spectral bands is illustrated. Finally, based on certain assumptions, the on-the-ground information available to range managers is estimated at 4422 bits/sq mile. The potential information obtainable from conventional measurement methods is estimated at 361 bits/sq mile for detailed walk-through observations and 552 bits/sq mile for quadrat sampling. This is contrasted with the significantly greater 2950 bits/sq mile which was calculated for classification results from ERTS images. (Author)

**A76-28056** Sensor equipment and its characteristics of the German airplane program for earth scientific research. P. Seige (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Satellitenelektronik, Oberpfaffenhofen, West Germany). In: Remote sensing of earth resources. Volume 4 - Proceedings of the Fourth Annual Conference on Earth Resources, Tullahoma, Tenn., March 24-26, 1975. Tullahoma, University of Tennessee, 1975, p. 77-98.

The German remote sensing program (scheduled to begin in the fall of 1975) described in this paper will use the Dornier Sky servant DO 28 D2 as a platform and will do research in the fields of oceanography, hydrology, geology, ecology and forestry. The sensor package consists of a series of Hasselblad cameras with different film-filter combinations, an infrared radiometer, a photogrammetric camera, an 11-channel multispectral line-scanner, a Landsat-compatible radiometer and a very complex avionic system. Along with the aircraft, a truck will be equipped with radiometers, cameras and meteorological instruments to make extensive ground truth measurements. B.J.

**A76-28063 \*** Practical applications of low, medium, and high altitude aircraft remote sensing data to land use planning. K. Drackett, T. W. D. Gregg, and J. Bale (Earth Satellite Corp., Washington, D.C.). In: Remote sensing of earth resources. Volume 4 - Proceedings of the Fourth Annual Conference on Earth Resources, Tullahoma, Tenn., March 24-26, 1975. Tullahoma, University of Tennessee, 1975, p. 203-231. 10 refs. Research supported by the U.S. Department of Housing and Urban Development; Contracts No. NAS5-21779; No. NAS9-13314.

Remotely sensed data is gaining wider acceptance in land use planning activities because of several inherent advantages offered by the technology. Scope of applications have increased to meet planners broadening responsibilities and needs for more comprehensive and specific information in response to new legislative mandates. Specific data needs associated with the land use planning process are varied. To illustrate how remote sensing surveys can be designed to meet a variety of goals at several planning levels, specific examples of the use of remotely sensed data and analysis techniques in four planning oriented land use surveys are discussed. These examples illustrate the use of aerial photography at the state planning level in Maryland and county level in Jefferson Parish, Louisiana. Special applications of aerial photography are demonstrated by energy planning in San Bernardino County, California and water management planning in New Castle County, Delaware.

(Author)

**A76-28066** An investigation into the use of multispectral photography for soil surveying in upland Britain. E. V. Brack (Aston, University, Birmingham, England). In: Remote sensing of earth resources. Volume 4 - Proceedings of the Fourth Annual Conference

on Earth Resources, Tullahoma, Tenn., March 24-26, 1975.

Tullahoma, University of Tennessee, 1975, p. 255-265.

Air photo-interpretation methods, using panchromatic photography, are used by the Soil Survey of England and Wales for soil Standard statistical simple correlation and linear regression analyses revealed a high correlation between the two estimation methods. In crops such as grain, sorghum, corn, and forage sorghum, in which the broadest part of the leaf canopy is near the top of the plant, there was a tendency to overestimate the per cent ground cover from aerial photographs.

C.K.D.

**A76-28069** Use of additive color viewer for interpretation of ERTS imagery for soil mapping with respect to a part of north western India. H. S. Iyer (Indian Photo-Interpretation Institute, Dehra Dun, India). In: Remote sensing of earth resources. Volume 4 - Proceedings of the Fourth Annual Conference on Earth Resources, Tullahoma, Tenn., March 24-26, 1975.

Tullahoma, University of Tennessee, 1975, p. 293-300. 12 refs.

It has been shown that ERTS-1 imagery can be used for the preparation of small-scale soil maps. The imagery used comprised the 70 mm format diapositives of two ERTS-1 frames covering a section of northwestern India on a scale of 1:3,690,000. The different bands of the imagery were projected by an additive color viewer, yielding a screen image on a scale of about 1:1,000,000. Physiographic boundary delineations were of excellent quality. The soil compositions of the mapped units were designated on the basis of limited ground studies. Best results for the interpretation of black and white imagery were obtained with bands five and seven. The color composite was of significantly higher quality than the black and white imagery.

C.K.D.

**A76-28074 \*** Investigations of remote sensing techniques for early detection of Dutch elm disease. R. S. Hammerschlag (U.S. Department of the Interior, National Park Service, Washington, D.C.) and W. J. Sopstyle (NASA, Wallops Flight Center, Wallops Island, Va.). In: Remote sensing of earth resources. Volume 4 - Proceedings of the Fourth Annual Conference on Earth Resources, Tullahoma, Tenn., March 24-26, 1975.

Tullahoma, University of Tennessee, 1975, p. 357-385. 18 refs.

Several forms of aerial photography were pursued in quest of a technique which could provide early detection of Dutch elm disease. The two most promising techniques tested were multispectral photography with object enhancement and band ratioing coupled with scanning microdensitometry. For practical purposes the multispectral system has the advantage of providing a readily interpretable image in a relatively short time. Laboratory studies indicated that less emphasis should be placed on the use of a red filter or the near infrared beyond 750 nm for early detection of stress within a single plant species. Color infrared film would be optimal when used for a long term detection of loss of plant vigor which results in a physical change in a plant canopy, but should find minimal practicality for early detection of specific sources of plant stress such as Dutch elm disease. Considerable discretion should be used when interpreting imagery on copy film because of loss of resolution and color definition.

(Author)

**A76-28086 \*** Evaluation of ERTS MSS digital data for monitoring water in the lower Chesapeake Bay area. D. E. Bowker and W. G. Witte (NASA, Langley Research Center, Hampton, Va.). In: Remote sensing of earth resources. Volume 4 - Proceedings of the Fourth Annual Conference on Earth Resources, Tullahoma, Tenn., March 24-26, 1975.

Tullahoma, University of Tennessee, 1975, p. 591-600. 5 refs.

Water samples collected during the ERTS overpasses of the lower Chesapeake Bay area have been analyzed for chlorophyll, particles, and sediment. Five ERTS images were sufficiently cloud free that a correlation analysis of radiance values from the MSS bands with the water parameters could be performed. A low

correlation was established for chlorophyll, except during algal blooms, when band 6 was responsive. There was a fair to good correlation with particles for combinations of band 5, particularly bands (5 minus 6). Sediment correlations were excellent for band 5 or combinations of band 5 with bands 4 and 6. It was evident that such factors as the atmosphere, tide, and different water masses were tending to confuse the data.

(Author)

**A76-28087 \*** Application of ERTS-1 and multiplexed SLAR imagery for the study of flooded shorelines. M. L. Bryan (Michigan, Environmental Research Institute, Ann Arbor, Mich.). In: Remote sensing of earth resources. Volume 4 - Proceedings of the Fourth Annual Conference on Earth Resources, Tullahoma, Tenn., March 24-26, 1975.

Tullahoma, University of Tennessee, 1975, p. 601-619. 7 refs. Contract No. NAS5-21783. NASA Task 6.

The major purpose of this study is to determine the accuracy of visual interpretations of data from two different sensors (ERTS-1; ERIM's multiplexed SLAR) for the study of flooded shorelines. Uncomplicated and primarily visual interpretation techniques are employed. These methods are considered most readily available to officials of local and small regional organizations who may need rapid reconnaissance mapping and information for the organization of disaster relief. Assumptions concerning the timely receipt of such remotely sensed data by those directing the relief have been made. Generally, it is determined that ERTS-1 and SLAR data are complementary, especially with respect to the interpretation of urban or built-up areas which are flooded, and together they can provide the necessary information for guiding relief operations.

(Author)

**A76-28096 \*** A statistical analysis of data extraction for land cover information from high-altitude and satellite images. R. W. Kiefer, W. W. Kuhlman, and S. L. Wynn (Wisconsin, University, Madison, Wis.). In: Remote sensing of earth resources. Volume 4 - Proceedings of the Fourth Annual Conference on Earth Resources, Tullahoma, Tenn., March 24-26, 1975.

Tullahoma, University of Tennessee, 1975, p. 759-781. Contract No. NAS5-21754.

Land cover information from a 10 by 30 km test site in eastern Wisconsin extracted using 70 mm positive LANDSAT transparencies in an additive color viewer at a scale of 1:500,000 was compared with land cover information extracted using LANDSAT 9 x 9 inch positive transparencies at a scale of 1:1,000,000. Color infrared photography (NASA RB-57) at a scale of 1:60,000 provided ground truth for each land cover type. Interpretations were made for four land cover classes: (1) forest-brushland; (2) structures-barren land; (3) surface water; and (4) agricultural-open land. Statistical comparisons showed that neither method for the extraction of this data was clearly superior.

B.J.

**N76-16513\*#** Department of the Environment, Ottawa (Ontario). Applied Hydrology Div.

**RETRANSMISSION OF HYDROMETRIC DATA IN CANADA Progress Report, 1 Apr. - 30 Sep. 1975**

R. A. Halliday, Principal Investigator and I. A. Reid Oct. 1975. 12 p refs. Sponsored by NASA ERTS (E76-10090; NASA-CR-145993) Avail: NTIS HC \$3.50 CSCL 14B

The author has identified the following significant results. The feasibility of transmitting hydrometric data to polar orbiting spacecraft and using these data for quasi-operational purposes was demonstrated.

**N76-16521\*#** Geological Survey, Reston, Va.

**PERFORMANCE OF THE LANDSAT-DATA COLLECTION SYSTEM IN A TOTAL SYSTEM CONTEXT Final Report**

Richard W. Paulson, Principal Investigator and Charles F. Merk Nov. 1975 29 p refs ERTS (NASA Order S-70243-AG)



## 08 INSTRUMENTATION AND SENSORS

(E76-10098; NASA-CR-146031) Avail: NTIS HC \$4.00 CSCL 05B

The author has identified the following significant results. This experiment was, and continues to be, an integration of the LANDSAT-DCS with the data collection and processing system of the Geological Survey. Although an experimental demonstration, it was a successful integration of a satellite relay system that is capable of continental data collection, and an existing governmental nationwide operational data processing and distributing networks. The Survey's data processing system uses a large general purpose computer with insufficient redundancy for 24-hour a day, 7 day a week operation. This is significant, but soluble obstacle to converting the experimental integration of the system to an operational integration.

**N76-16560\*** National Aeronautics and Space Administration, Lyndon B. Johnson Space Center, Houston, Tex.

**SKYLAB 4 VISUAL OBSERVATIONS PROJECT REPORT**  
J. L. Kaltenbach, W. B. Lenoir, M. C. McEwen, R. A. Weitenhagen, and V. R. Wilmarth Jun. 1974 249 p  
(NASA-TM-X-58142; JSC-09053) Avail: NTIS HC \$8.00 CSCL 22A

The Skylab 4 Visual Observations Project was undertaken to determine the ways in which man can contribute to future earth-orbital observational programs. The premission training consisted of 17 hours of lectures by scientists representing 16 disciplines and provided the crewmen information on observational and photographic procedures and the scientific significance of this information. During the Skylab 4 mission, more than 850 observations and 2000 photographs with the 70-millimeter Hasselblad and 35-millimeter Nikon cameras were obtained for many investigative areas. Preliminary results of the project indicate that man can obtain new and unique information to support satellite earth-survey programs because of his inherent capability to make selective observations, to integrate the information, and to record the data by describing and photographing the observational sites. Author

**N76-16586\*** National Environmental Satellite Service, Washington, D.C.

**REMOTE SENSING OF SNOWPACK DENSITY USING SHORTWAVE RADIATION**

Michael C. McMillan and James L. Smith (Pacific Southwest Forest and Range Experiment Station) In NASA, Goddard Space Flight Center Operational Appl. of Satellite Snowcover Observations 1975 p 361-373 refs

(Paper-25) CSCL 08L

Albedo or satellite radiance measurements can be used to estimate average snowpack density by means of a multiple linear equation. The in situ data equation predicted density with a correlation (sq r) of 0.79 and a standard error of 0.027 gm/cu cm. The data from LANDSAT-1 were not as significant in a similar equation, possibly because of the large field of view. Author

**N76-16596\*** Texas A&M Univ., College Station. Remote Sensing Center.

**GROUND TRUTH REPORT 1975 PHOENIX MICROWAVE EXPERIMENT**

Bruce J. Blanchard 21 Nov. 1975 294 p  
(Contract NAS9-13904; NASA Order T-5459-C)  
(NASA-CR-147427; TR-RSC-70) Avail: NTIS HC \$9.25 CSCL 08M

Direct measurements of soil moisture obtained in conjunction with aircraft data flights near Phoenix, Arizona in March, 1975 are summarized. The data were collected for the Joint Soil Moisture Experiment. Author

**N76-16607\*** Environmental Research Inst. of Michigan, Ann Arbor. Infrared and Optics Div.

**REMOTE SENSING STUDIES IN THE NEW YORK BIGHT**  
Final Report

C. T. Wezernak, D. R. Lyzenga, and F. C. Polcyn Jul. 1975 75 p refs

(COM-75-11358/9; ERIM-109300-5-F; NOAA-75082104)  
Avail: NTIS HC \$4.50 CSCL 08J

The results are described of a remote sensing program of data collection and analysis undertaken in the New York Bight. Aircraft multispectral missions were carried out on 7 April 1973. The morning mission on that date coincided with the ERTS-1 satellite pass over the area. The principal objectives of the program were to provide data, which when combined with shipboard measurements, would describe the surface waters of the area and their general circulation. Specifically the remote sensing program was designed to provide the following information: (1) sea surface temperature distribution, (2) surface chlorophyll concentrations, (3) secchi disc transparency, (4) document ocean dumping practices, and (5) movement of water masses as evidenced by dye tracer materials. GRA

**N76-16684\*** Old Dominion Univ. Research Foundation, Norfolk, Va. Dept. of Physics and Geophysical Sciences.

**DIFFERENTIAL ABSORPTION AND SCATTERING SENSITIVITY PREDICTIONS** Technical Report, Jun. 1974 - Nov. 1975

Richard T. Thompson, Jr. Dec. 1975 43 p refs  
(Grant NSG-1060)

(NASA-CR-146139; PGSTR-PH75-19) Avail: NTIS HC \$4.00 CSCL 04A

Equations for evaluating the sensitivity of the Differential Absorption and Scattering (DAS) technique based upon a conventional analysis of statistical errors were derived. The equations were put in a proper form for evaluating total column density and range resolved concentration measurements of several atmospheric species. The equations were subsequently used to analyze the sensitivity of DAS in three specific applications assuming realistic parameters for the optical and electronic components of proposed DAS systems. The three DAS applications evaluated were: (1) measurement of nitrogen dioxide at ground levels over a horizontal path, (2) measurement of ozone depletion in the wake of a jet engine at 20 km altitude, and (3) measurements of ozone distribution from an orbiting space platform, in a downward viewing mode. The results of this study demonstrate that with reasonable laser energy and telescope receiver dimensions, DAS is capable of meeting requirements for performing these measurements. Author

**N76-17449\*** Minnesota State Planning Agency, St. Paul.

**ANALYSIS OF DATA FOR LANDSAT (ERTS) FOLLOW-ON**  
Progress Report, 26 Sep. - 25 Dec. 1975

Joseph E. Sizer, Principal Investigator 26 Jan. 1976 18 p refs ERTS

(Contract NAS5-20985)

(E76-10140; NASA-CR-146149) Avail: NTIS HC \$3.50 CSCL 05B

The author has identified the following significant results. Daily weather service satellite photographs of the midwest were found to be of great assistance before ordering EROS Data Center products. These weather satellite images are a quick and inexpensive record of the location of cloud masses, which supplements the percent of cloud catalogues. Savings of time and money were made because the location of cloud cover was known before any imagery was ordered.

**N76-17488\*** National Aeronautics and Space Administration, Lyndon B. Johnson Space Center, Houston, Tex.

**AN OVERVIEW OF THE DEVELOPMENT OF REMOTE SENSING TECHNIQUES FOR THE SCREWORM ERADICATION PROGRAM**

Charles M. Barnes and Frank C. Forsberg (Lockheed Electronics Co., Houston, Tex.) In its NASA Earth Resources Survey Symp. Vol. 1-A: Agr., Environment Jun. 1975 p 263-287 refs  
(E-2) CSCL 06C

The current status of remote sensing techniques developed for the screwworm eradication program of the Mexican-American Screwworm Eradication Commission was reported. A review of the type of data and equipment used in the program is presented. Future applications of remote sensing techniques are considered. Author

**N76-17497\*** Lund Univ. (Sweden). Dept. of Physical Geography.

**THE USE OF LANDSAT-1 IMAGERY FOR WATER QUALITY STUDIES IN SOUTHERN SCANDINAVIA**

Ulf Hellden /In NASA. Lyndon B. Johnson Space Center NASA Earth Resources Survey Symp. Vol. 1-A: Agr., Environment Jun. 1975 p 451-468 refs

(E-13) CSCL 08H

The possibilities of using LANDSAT-1 images for environmental studies, with special references to water quality studies, were investigated by selecting test areas in southern Scandinavia. The MSS images of different bands are compared under the magnification of an Interpretoscope and densitometric analyses are performed in a Schnell-photometer. The possibility of tracing pollution plumes is studied in the Oresund outside Copenhagen. The effect of different sewers and the circulation of the polluted water is analyzed in various situations. The variation in reflectivity of a great number of lakes in South and Middle Sweden is studied by means of densitometric analyses and significant regional differences are found. The correlation with in situ measurements of water quality (turbidity and secchi disc transparency) of the sampled lakes (made by the National Swedish Environment Protection Board) is fairly good. Author

**N76-17515\*** Michigan Technological Univ., Houghton. **SKYLAB PHOTOGRAPHY APPLIED TO GEOLOGIC MAPPING IN NORTHWESTERN CENTRAL AMERICA**

W. I. Rose, Jr., D. J. Johnson, G. A. Hahn, and G. W. Johns /In NASA. Lyndon B. Johnson Space Center NASA Earth Resources Survey Symp., Vol. 1-B Jun. 1975 p 869-884 refs

(G-17) CSCL 08G

Two photolineation maps of southwestern Guatemala and Chiapas were made from S190 photographs along a ground track from Acajutla, El Salvador to San Cristobal de las Casas, Mexico. The maps document a structural complexity spanning the presumed triple junction of the Cocos, Americas, and Caribbean plates. The Polochic fault zone, supposedly the Americas-Caribbean plate boundary, is a sharply delineated feature across western Guatemala. Westward of the Mexican border it plays into a large number of faults with NW to SW trends. The structural pattern is quite different to the north (Americas plate) and to the south (Caribbean plate) of the Polochic fault, though both areas are dominated by NW-trending lineations. Within the Central American volcanic chain, the lineation patterns support the segmented model of the Benioff Zone, by showing a concentration of transverse lineations in the predicted locations, most notably NE-trending elements near Quezaltenango, Guatemala. The structural pattern obtained from the maps are compared to patterns described on recently published maps of more southerly parts of Central America, to begin a synthesis of the structure of the convergent plate boundary. Author

**N76-17539\*** National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

**REMOTE SENSING AS AN INNOVATION: HOW CAN WE IMPROVE ON ITS RATE OF ADOPTION?**

Buzz Sellman /In NASA. Lyndon B. Johnson Space Center NASA Earth Resources Survey Symp., Vol. 1-B Jun. 1975 p 1317-1321 refs

(I-15) CSCL 05B

Earth Resources investigation programs are discussed which were designed to apply contemporary remote sensing technologies to 'user' needs. The potential adopter's environment and arena

of work are considered and his expectations and measures of success. M.J.S.

**N76-17540\*** Bendix Corp., Ann Arbor, Mich.

**M-DAS: SYSTEM FOR MULTISPECTRAL DATA ANALYSIS**

Robert H. Johnson /In NASA. Lyndon B. Johnson Space Center NASA Earth Resources Survey Symp., Vol. 1-B Jun. 1975 p 1323-1350

(I-16) CSCL 05B

M-DAS is a ground data processing system designed for analysis of multispectral data. M-DAS operates on multispectral data from LANDSAT, S-192, M2S and other sources in CCT form. Interactive training by operator-investigators using a variable cursor on a color display was used to derive optimum processing coefficients and data on cluster separability. An advanced multivariate normal-maximum likelihood processing algorithm was used to produce output in various formats: color-coded film images, geometrically corrected map overlays, moving displays of scene sections, coverage tabulations and categorized CCTs. The analysis procedure for M-DAS involves three phases: (1) screening and training, (2) analysis of training data to compute performance predictions and processing coefficients, and (3) processing of multichannel input data into categorized results. Typical M-DAS applications involve iteration between each of these phases. A series of photographs of the M-DAS display are used to illustrate M-DAS operation. Author

**N76-17543\*** California Univ., Berkeley. Remote Sensing Research Program.

**THE INTEGRATION OF MANUAL AND AUTOMATIC IMAGE ANALYSIS TECHNIQUES WITH SUPPORTING GROUND DATA IN A MULTISTAGE SAMPLING FRAMEWORK FOR TIMBER RESOURCE INVENTORIES: THREE EXAMPLES**

Michael Gialdini, Stephen Titus, James Nichols, and Randall Thomas /In NASA. Lyndon B. Johnson Space Center NASA Earth Resources Survey Symp., Vol. 1-B Jun. 1975 p 1377-1387 refs

(I-19) CSCL 05B

An approach to information acquisition is discussed in the context of meeting user-specified needs in a cost-effective, timely manner through the use of remote sensing data, ground data, and multistage sampling techniques. The roles of both LANDSAT imagery and Skylab photography are discussed as first stages of three separate multistage timber inventory systems and results are given for each system. Emphasis is placed on accuracy and meeting user needs. Author

**N76-17570\*** American Association for the Advancement of Science, Washington, D.C.

**INTERACTIVE MULTI-SPECTRAL ANALYSIS OF MORE THAN ONE SONRAI VILLAGE IN NIGER, WEST AFRICA**

Priscilla Reining and Dwight D. Egbert (GE Co., Beltsville, Md.) /In NASA. Lyndon B. Johnson Space Center NASA Earth Resources Survey Symp., Vol. 1-C Jun. 1975 p 1811-1821 refs

(L-20) CSCL 08B

Use of LANDSAT data and an interaction system is considered for identifying and measuring small scale compact human settlements (villages) for demographic and anthropological studies. Because village components are not uniformly distributed within any one village, they apparently are multimodal, spectrally. Therefore, the functions of location and enumeration are kept separate. Measurement of a known village is compared with CCT response. Author

**N76-17575\*** National Oceanic and Atmospheric Administration, Miami, Fla. Sea-Air Interaction Lab.

**A COMPARISON OF SKYLAB S-193 AND AIRCRAFT VIEWS OF SURFACE ROUGHNESS AND A LOOK TOWARD SEASAT**

Duncan Ross /In NASA. Lyndon B. Johnson Space Center NASA Earth Resources Survey Symp., Vol. 1-C Jun. 1975

## 08 INSTRUMENTATION AND SENSORS

p 1911-1936 refs (For availability see N76-17552 08-43) (M-2) CSCL 08B

An extensive aircraft underflight program was conducted along the Skylab groundpath for the purpose of documenting wind, wave, and atmospheric conditions affecting the amplitude of the active and passive microwave signatures. The S-193 microwave system senses a roughness parameter at the ocean surface that is proportional to the surface windspeed. The aircraft program is described, and some comparisons of satellite and aircraft results are presented. The principal result of the comparison of active radar is that direct inferences of the surface windspeed are possible, but subject to considerable scatter, and that this scatter appears to be due to interaction between long gravity and short Bragg waves and backscatter due to rain as well as errors in correcting for azimuth dependence. An unforeseen opportunity to observe a Pacific hurricane by both Skylab and NOAA aircraft has contributed to the development of a simplified wave forecasting scheme applicable to hurricanes, and more general conditions, which combines the better qualities of both spectral and height/period forecasting techniques. Horizontal polarization data obtained by the aircraft in Hurricane Ava, and in other experiments, which led to this development are presented.

Author

### **N76-17576\*** Kansas Univ. Center for Research, Inc., Lawrence. **SKYLAB S-193 RADSCAT MICROWAVE MEASUREMENTS OF SEA SURFACE WINDS**

R. K. Moore, A. K. Fung, J. Young, J. Claassen, H. Chan, M. Afarani, W. J. Pierson, V. J. Cardone, J. Hayes, W. Spring et al. In NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975 p 1937-1952 refs Prepared in cooperation with City Univ. of New York

(M-3) CSCL 04B

The S-193 Radscat made extensive measurements of many sea conditions. Measurements were taken in a tropical hurricane (Ava), a tropical storm (Christine), and in portions of extratropical cyclones. Approximately 200 scans of ocean data at 105 kilometer spacings were taken during the first two Skylab missions and another 200 during the final mission when the characteristics of the measurements changed due to damage of the antenna. Backscatter with four transmit/receive polarization combinations and emissions with horizontal and vertical receive polarizations were measured. Other surface parameters investigated for correlation with the measurements included sea temperature, air/sea temperature difference, and gravity-wave spectrum. Methods were developed to correct the microwave measurements for atmospheric effects. The radiometric data were corrected accurately for clear sky and light cloud conditions only. The radiometer measurements were used to recover the surface scattering characteristics for all atmospheric conditions excluding rain. The radiometer measurements also detected the presence of rain which signaled when the scattering measurement should not be used for surface wind estimation. Regression analysis was used to determine empirically the relation between surface parameters and the microwave measurements, after correction for atmospheric effects. Results indicate a relationship approaching square-law at 50 deg between differential scattering coefficient and wind speed with horizontally polarized scattering data showing slightly more sensitivity to wind speed than vertically polarized data.

Author

**N76-17630#** Institut Geographique National, Paris (France). Groupement Recherche, Etudes et Developpement. **APPLICATION OF PHOTOGRAMMETRIC CAMERAS AND SENSORS FOR EARTH SURVEY MISSION USING SPACELAB [ETUDE SUR L'EMPLOI DE CHAMBRES PHOTOGRAMMETRIQUES ET DE CAPTEURS POUR DES MISSIONS DE LEVES TERRESTRES UTILISANT SPACELAB]** Sep. 1975 193 p refs In FRENCH (Contract ESRO-SC/68-HQ) (ESA-CR(P)-718) Avail: NTIS HC \$7.50

A study on photogrammetric systems and sensors for earth survey onboard spacelab is presented. The characteristics of photogrammetric, orthophotographic, and MSS cameras, are

reviewed. Detailed analyses were carried out on camera choice types of photographic films, film stockpile, rotating mirrors, and optical quality windows.

### **N76-17631** Institut Geographique National, Paris (France). **FINAL SUMMARY REPORT [RAPPORT SOMMAIRE FINAL]**

Guy Ducher In its Appl. of Photogrammetric Cameras and Sensors for Earth Survey Mission Using Spacelab 24 Jun. 1975 44 p refs In FRENCH (GRED/GD/149)

The definition of a system of metric chambers and multispectral band cameras for earth photogrammetry onboard Spacelab is reviewed. User needs are detailed with regard to detectability and image acutance for cartographic uses with 10 meters detectability and 20 meters resolution. The altimetric conditions for Spacelab are derived. The favorable spectral bands required are discussed leading to an overall proposal for orthophotography equipment and multispectral band cameras. The optical window requirements are detailed to suit the cameras. Film supplies and film quality are considered. A general schedule for manufacture, testing, and reception of the systems is outlined. ESA

### **N76-17632** Institut Geographique National, Paris (France). **CHOICE OF CAMERAS AND ITS IMPLEMENTATION [RAPPORT TECHNIQUE SUR LE CHOIX DU MATERIEL DE PRISE DE VUES ET SA MISE EN OEUVRE]**

J. Ducloux In its Appl. of Photogrammetric Cameras and Sensors for Earth Survey Mission Using Spacelab May 1975 27 p In FRENCH

The performance of various types of camera for earth photogrammetry and orthophotography onboard Spacelab are reviewed. An estimate of image quality and ground detectability is given together with an assessment of possible cartographic uses. Image motion compensation aspects are detailed using the transfer function theory. Implementation of the equipment on the Spacelab pallet or inside the cabin is reviewed with regard to temperature and pressure effects, hard radiation effects, optical window dimensions, and mechanical fixation. Elements for camera choice are given with regard to performance, ease of use, costs, and image exploitation. A timetable for manufacture, test, and acceptance, is proposed. ESA

### **N76-17633** Institut Geographique National, Paris (France). **DEFINITION OF THE SPACELAB MULTISPECTRAL BAND CAMERAS [RAPPORT SUR LA DEFINITION DES CHAMBRES DE PRISE DE VUES MULTI-SPECTRALES DU SATELLITE SPACELAB]**

Alain Baudoin In its Appl. of Photogrammetric Cameras and Sensors for Earth Survey Mission Using Spacelab 22 May 1975 14 p In FRENCH (GRED/AB/119)

User requirements for MSS onboard Spacelab are reviewed with regard to spatial resolution from which conditions on Spacelab altitude, focal length, film resolution, and image motion compensation are derived. The useful spectral bands are discussed together with superposing images, field of view problems, and radiometric precision. Criteria for choice of the MSS equipment are given with regard to lenses, film type, and focal length. ESA

### **N76-17635** Institut Geographique National, Paris (France). **GROUND COVERAGE OF AN INCLINED MIRROR CAMERA [LARGEUR AU SOL COUVERTE PAR UNE CHAMBRE A MIROIR INCLINABLE]**

Guy Ducher In its Appl. of Photogrammetric Cameras and Sensors for Earth Survey Mission Using Spacelab 14 May 1975 12 p In FRENCH (GRED/GD/117)

The advantages of a rotating mirror to compensate for image movement and enhance the field of view of the photogrammetric camera onboard Spacelab are reviewed. The resulting scale effect and ground strip covered width are calculated. Discussion of results led to choice of rotation angle at 15 degrees either way. ESA

**N76-17636** Engins Matra, Velizy (France).

**FEASIBILITY OF A LARGE OPTICAL WINDOW FOR SPACELAB [ETUDE DE FAISABILITE D'UNE FENETRE OPTIQUE DE GRANDES DIMENSIONS POUR LA NAVETTE SPACELAB]**

Jean-Pierre Elissalde / In Inst. Geograph. Natl. Appl. of Photogrammetric Cameras and Sensors for Earth Survey Mission during Spacelab 16 Apr. 1975 53 p In FRENCH

The parameters to be satisfied by the Spacelab optical window are reviewed with regard to optical factors and environmental factors such as radiation effects, vibration levels, thermal stresses, and shock resistance. Borosilicate glass versus pure silica glass is discussed. A detailed examination of parallelism tolerance, planeity, flexure, and temperature gradient effects, is performed. Antireflection coatings and heating coatings are evaluated. Radiation effects are discussed together with mechanical resistance aspects, such as window thickness, deformation, vibrations, mechanical reliability, humidity effects, fracture mechanics, and chemical annealing. Mechanical fixation and thermal stresses are detailed together with safety measures to be implemented. **ESA**

**N76-18597\*#** Department of the Environment, Ottawa (Ontario). **RETRANSMISSION OF HYDROMETRIC DATA IN CANADA. Quarterly Report, Oct. - Dec. 1975**

R. A. Halliday, Principal Investigator and I. A. Reid Jan. 1976 10 p Sponsored by NASA ERTS (E76-10176; NASA-CR-146376) Avail: NTIS HC \$3.50 CSCL 08H

The author has identified the following significant results. The project demonstrates the feasibility of transmitting hydrometric data to polar orbiting spacecraft and using these data on a quasi-operational basis. The implementation of the Alaska receive site in December had a significant impact on the Canadian experiment as the number of transmissions now received from some northern sites has increased substantially. Data are now received on as many as 11 orbits each day.

**N76-18614\*#** National Oceanic and Atmospheric Administration, Miami, Fla.

**SUMMARY OF RESULTS OF AN EXPERIMENT TO EVALUATE SKYLAB EARTH RESOURCES SENSORS FOR DETECTION OF THE GULF STREAM**

George A. Maul, Principal Investigator, Howard R. Gordon, Stephen R. Baig, Michel McCaslin, and Roger J. DeVivo [1975] 2 p Sponsored by NASA EREP (E76-10194; NASA-CR-146288) Avail: NTIS HC \$3.50 CSCL 08J

**N76-18621\*#** Department of the Environment, Ottawa (Ontario). **SOME OPERATIONAL USES OF SATELLITE RETRANSMISSION IN CANADA**

R. A. Halliday, Principal Investigator and I. A. Reid 1975 7 p refs Presented at 10th Intern. Symp. on Remote Sensing of Environment, Ann Arbor, Mich., 6-10 Oct. 1975 Sponsored by NASA ERTS (E76-10209; NASA-CR-146341) Avail: NTIS HC \$3.50 CSCL 17B

**N76-18629\*#** Massachusetts Inst. of Tech., Cambridge, Research Lab. of Electronics.

**THEORY OF PASSIVE REMOTE SENSING WITH MICROWAVES Final Report**

J. A. Kong 15 Jul. 1975 301 p refs (Contract JPL-953524)

(NASA-CR-146315) Avail: NTIS HC \$9.75 CSCL 14E

Theoretical models are described which were developed for use in the interpretation of microwave data from the earth's surface. **D.M.L.**

**N76-19506\*#** National Oceanic and Atmospheric Administration, Miami, Fla. Atlantic Oceanographic and Meteorological Labs.

**AN EXPERIMENT TO EVALUATE SKYLAB EARTH RESOURCES SENSORS FOR DETECTION OF THE GULF STREAM Final Report**

George A. Maul, Principal Investigator, Howard R. Gordon (Miami Univ., Coral Gables), Stephen R. Baig (Nova Univ., Dania), Michael McCaslin, and Roger J. DeVivo 1976 81 p refs. Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 EREP

(NASA Order T-4713-B)

(E76-10193; NASA-CR-147454) Avail: NTIS HC \$5.00 CSCL 08J

The author has identified the following significant results. An experiment to evaluate the Skylab earth resources package for observing ocean currents was performed in the Straits of Florida in January 1974. Data from the S190 photographic facility, S191 spectroradiometer and S192 multispectral scanner, were compared with surface observations. The anticyclonic edge of the Gulf Stream could be identified in the Skylab S190A and B photographs, but the cyclonic edge was obscured by clouds. The aircraft photographs were judged not useful for spectral analysis because vignetting caused the blue/green ratios to be dependent on the position in the photograph. The spectral measurement technique could not identify the anticyclonic front, but mass of Florida Bay water which was in the process of flowing into the Straits could be identified and classified. Monte Carlo simulations of the visible spectrum showed that the aerosol concentration could be estimated and a correction technique was devised.

**N76-19529\*#** Kanner (Leo) Associates, Redwood City, Calif. **SPACE PHOTOGRAPHY AND GEOLOGICAL STUDIES**

G. B. Gonin, ed., S. I. Strelnikov, ed., N. A. Yakovlev, E. M. Grishchuk, N. B. Davidson, A. V. Dolivodobrovolskiy, N. V. Kobets, V. V. Koltsov, V. P. Koroleva, N. V. Kravchuk et al Washington NASA Feb. 1976 523 p refs Transl. into ENGLISH of the book "Kosmicheskaya fotosyemka i Geologicheskoye Issledovaniya" Leningrad, Nedra Press, 1975 p 1-416 (Contract NASw-2790)

(NASA-TT-F-16852) Avail: NTIS HC \$12.75 CSCL 08G

Theoretical and practical problems of space photogrammetry and geological interpretation of space photographs are considered. Obtaining images of the sunlit surface of earth from spacecraft is examined, involving spacecraft orientation and laws of displacement deriving from celestial mechanics. Stress is placed on the effect of the atmosphere on the quality of imagery. Results of satellite-track experiments, involving the simultaneous photographing of several areas of the earth from space and from aircraft are presented, along with data on aircraft measurements of optical characteristics of certain landscape objects through significant atmospheric thickness. Space photogrammetry is represented by a technique for the rigorous solution of inverse photogrammetric intersection of space photographs, analysis of their measuring properties, transmission of space photographs, and compilation of photomaps in a given projection from space photographs. Also treated is stereophotogrammetry of space photographs. **Author**

**N76-19537\*#** TRW Systems Group, Redondo Beach, Calif. **EARTH RESOURCES MISSION PERFORMANCE STUDIES. VOLUME 1: REQUIREMENTS DEFINITION Final Report**

2 Aug. 1974 72 p refs

(Contract NAS9-14117)

(NASA-CR-147410; TRW-25651-6002-TU-01-Vol-1) Avail: NTIS HC \$4.50 CSCL 05B

The need for a realistic set of earth resources collection requirements to test and maximize the data gathering capabilities of the EOS remote sensor systems is considered. The collection requirements will be derived from established user requirements. In order to confine and bound the requirements study, some baseline assumptions were established. These are: (1) image acquisition is confined to the contiguous United States, (2) the fundamental data users are select participating federal agencies, (3) the acquired data will be applied to generating information

## 08 INSTRUMENTATION AND SENSORS

necessary or in support of existing federal agency charters, and (4) the most pressing or desired federal agency earth resources data requirements have been defined, suggested, or implied in current available literature. Author

**N76-19541#** DBA Systems, Inc., Melbourne, Fla.  
**SKYLAB ALTIMETRY DATA REDUCTIONS AND DEVELOPMENT OF PROGRAMS FOR PRE AND POST PROCESSING OF ALTIMETRY DATA FOR SARRA REDUCTIONS Final Report, Nov. 1974 - Jun. 1975**

Jerry E. Trotter Jun. 1975 60 p refs  
(Contract F19628-75-C-0090; AF Proj. 7600)  
(AD-A015813; AFCRL-TR-75-0359) Avail: NTIS CSCL 08/5

The reductions of the skylab altimetry data offered the first opportunity to reduce real data with the SARRA computer program. The results from residual evaluations clearly illustrate the presence of a severe undulation in the vicinity of the Puerto Rico Trench. Pre and post processing programs were developed to supplement the operation of the program SARRA and to assist in the evaluation and presentation of the geoid results obtained from SARRA reductions. GRA

**N76-21659\*#** Purdue Univ., Lafayette, Ind. Lab. of Applications of Remote Sensing.

**COMPUTER-AIDED ANALYSIS OF LANDSAT-1 MSS DATA: A COMPARISON OF THREE APPROACHES, INCLUDING A MODIFIED CLUSTERING APPROACH**

R. M. Hoffer, Principal Investigator, M. D. Fleming, and J. S. Berkebile 1975 9 p refs EREP  
(Contracts NAS9-14016; NAS5-21880; NAS9-13380)  
(E76-10292; NASA-CR-147536; LARS-Info-Note-072475)  
Avail: NTIS HC \$3.50 CSCL 05B

**N76-21666#** Messerschmitt-Boelkow-Blohm G.m.b.H., Ottonbrunn (West Germany). Unternehmensbereich Flugzeuge.

**COMPARATIVE INVESTIGATION ON RECOGNITION RANGES OF IR AND TV SENSORS SUBJECTED TO VARIOUS ENVIRONMENTAL AND WEATHER CONDITIONS**

Helmut Ostermeier 15 May 1974 106 p refs In GERMAN; ENGLISH summary  
(MBB-UFE-1093-O) Avail: NTIS HC \$5.50

Investigations are reported on remote sensing of the earth from an aircraft. Sensors considered are low light level TV cameras and infrared scanners for the wavelength range 8 to 14 micron. Calculations show that remote sensing with TV is possible only under favourable lighting conditions (daylight, clear full moon). IR scanner sensing is possible at night and under nearly all environmental and weather conditions. IR scanners are superior to the TV cameras for mist and fog conditions. Loss of contrast due to rain is a disadvantage for the scanner. Wide range IR scanning is possible for artificially treated targets, e.g. running combustion engines. ESA

## 09 GENERAL

Includes economic analysis.

**A76-18902**      **Symposium on Machine Processing of Remotely Sensed Data, 2nd, Purdue University, West Lafayette, Ind., June 3-5, 1975, Proceedings.** Symposium sponsored by the American Society of Agronomy, IEEE, Crop Science Society of America, Purdue University, and Soil Science Society of America. Edited by C. D. McGillem (Purdue University, West Lafayette, Ind.). New York, Institute of Electrical and Electronics Engineers, Inc., 1975. 351 p. \$25.

Papers are presented on computer analysis techniques for forest and agricultural applications, water resources data processing, the monitoring and evaluation of natural resources, and the analysis of land use and geological imagery. Also discussed are analysis algorithms, clustering and feature selection, image processing and pattern recognition techniques. Emphasis throughout is on satellite data, with particular emphasis on Landsat multispectral band scanner imagery.

B.J.

**A76-20118**      **Missions to Salyut 4. II. G. R. Hooper. *Spaceflight*, vol. 18, Jan. 1976, p. 13-18.**

The flight of Soyuz 18 is described along with the tasks performed by the Soyuz 18 astronauts aboard the Salyut 4 space station from May 25 to July 26, 1975. The docking operation is outlined, and detailed accounts are given of the biological experiments, X-ray observations, studies of the physical properties of the space environment, and spectrometric observations of earth's atmosphere. A test of the Cascade navigation system is discussed along with studies of micrometeoroids, cosmic rays, the earth's surface, and processes in the upper atmosphere. Other tasks described include UV spectrographic observations of the solar disk, exercises in stellar navigation, observations of a solar flare, medical experiments, a spectrographic study of Sco X-1, spectral sounding of the upper atmosphere in the UV and IR regions, observations of atmospheric pollution, and photographic and spectroscopic studies of aurora borealis. The reentry flight is reviewed, and the results of postflight medical examinations of the astronauts are discussed.

F.G.M.

**A76-21497**      **Colloquium on the Law of Outer Space, 17th, Amsterdam, Netherlands, October 1-4, 1974, Proceedings.** Colloquium sponsored by the International Astronautical Federation. Edited by M. D. Schwartz (California, University, Davis, Calif.). Davis, Calif., University of California; South Hackensack, N.J., Fred B. Rothman and Co., 1975. 406 p. In English, French, and Spanish. \$25.

The reports deal with legal aspects of direct broadcasting by satellites, current prospects of space law, the interpretation of space treaties, and a variety of more specific subjects involving applications of international law to space activities. Topics include a review of proposed international agreements concerning direct broadcasts from satellites, some legal aspects of the use of communication satellites, a proposal for a convention on remote sensing, legal problems posed by the creation of the European Space Agency, and the liability of international governmental organizations in space law. Consideration is also given to a proposed international convention in aerial and space collisions, the juridical nature of celestial bodies, legal aspects of space stations and earth-resource satellites, international cooperation in the use of space laboratories, a convention on international liability for damage caused by space objects, and the galactic extension of space law.

F.G.M.

**A76-22626**      **Electricity: An expanding technology; Proceedings of the Southeast Region 3 Conference, Charlotte, N.C., April 6-9, 1975. Volumes 1 & 2.** Conference sponsored by the Institute of Electrical and Electronics Engineers. New York, Institute of Electrical and Electronics Engineers, Inc., 1975. Vol. 1, 406 p.; vol. 2, 397 p. Price of two volumes, \$24.

Topics considered include the design and operation of power transformers, electrical transportation systems, semiconductor devices, systems for power transmission and distribution, electric batteries, power systems analysis, and wire and cable technology. Also considered are control systems theory, multiplexing and data acquisition, antenna science, computer design and computerized design, target acquisition and signal processing and thin film technology. Engineering management, environment protection and engineering, laser technology, electronic engineering, operator interfaces, biomedical engineering, computers for control and circuit theory, and filter design are also discussed.

B.J.

**N76-16589\***      **National Weather Service, Portland, Ore. APPLICATION OF BAYESIAN DECISION THEORY TO AIRBORNE GAMMA SNOW MEASUREMENT**

Vernon C. Bissell. In NASA. Goddard Space Flight Center Operational Appl. of Satellite Snowcover Observations 1975 p. 409-420 refs (Paper-28) CSCL 08L

Measured values of several variables are incorporated into the calculation of snow water equivalent as measured from an aircraft by snow attenuation of terrestrial gamma radiation. Bayesian decision theory provides a snow water equivalent measurement by taking into account the uncertainties in the individual measurement variables and filtering information about the measurement variables through prior notions of what the calculated variable (water equivalent) should be.

Author

**N76-16652**      **California Univ., Davis. TOWARD A MATHEMATICAL THEORY OF ENVIRONMENTAL MONITORING. THE INFREQUENT SAMPLING PROBLEM Ph.D. Thesis**

Kenneth David Pimentel 1975 398 p  
 Avail: Univ. Microfilms Order No. 76-1802

An environmental monitor is taken to be a system which generates estimates of environmental pollutant levels throughout an environmental region for all times within a time interval of interest from measurement data taken only at discrete times and only at discrete locations in that region. The following optimal environmental monitoring problems are addressed: determine the optimal monitoring program - the numbers and types of measurement devices, the locations where they are deployed and the timing of those measurements - which minimizes the total cost of taking measurements while maintaining the error in the pollutant estimate below some bound throughout the time interval of interest. Diffusive pollutant transport in distributed environmental systems is treated with the method of separation of variables to obtain a set of stochastic first-order ordinary differential state equations for the process.

Dissert. Abstr.

**N76-17469\*#**      **National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.**

**NASA EARTH RESOURCES SURVEY SYMPOSIUM. VOLUME 1-A: AGRICULTURE, ENVIRONMENT First Comprehensive Symposium on the Practical Application of Earth Resources Survey Data**

Jun. 1975 600 p refs Symp. held at Houston, Tex., 9-12 Jun. 1975 See also Vol. 1-B N76-17501; Vol. 1-C N76-17552; Vol. 1-D N76-17588; Vol. 3 N76-17613; Original contains color imagery. Original NASA photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 (NASA-TM-X-58168-Vol-1-A; JSC-09930-Vol-1-A) Avail: NTIS HC \$7.25 CSCL 05B

A number of papers dealing with the practical application

## 09 GENERAL

of imagery obtained from remote sensors on LANDSAT satellites, the Skylab Earth resources experiment package, and aircraft to problems in agriculture and the environment were presented. Some of the more important topics that were covered included: range management and resources, environmental monitoring and management, crop growth and inventory, land management, multispectral band scanners, forest management, mapping, marshlands, strip mining, water quality and pollution, ecology.

**N76-17525\*** Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.

### **LAYERED CLASSIFICATION TECHNIQUES FOR REMOTE SENSING APPLICATIONS**

R. H. Swain; C. L. Wu, D. A. Landgrebe, and H. Hauska / In NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 1087-1097 refs

(Contract NAS9-14016; Grant NGL-15-005-112)

(I-1) CSCL 08B

The single-stage method of pattern classification utilizes all available features in a single test which assigns the unknown to a category according to a specific decision strategy (such as the maximum likelihood strategy). The layered classifier classifies the unknown through a sequence of tests, each of which may be dependent on the outcome of previous tests. Although the layered classifier was originally investigated as a means of improving classification accuracy and efficiency, it was found that in the context of remote sensing data analysis, other advantages also accrue due to many of the special characteristics of both the data and the applications pursued. The layered classifier method and several of the diverse applications of this approach are discussed. Author

**N76-17530\*** Forest Service, Ogden, Utah.

### **REMOTE SENSING: A VALUABLE TOOL IN THE FOREST SERVICE DECISION MAKING PROCESS**

Fleet L. Stanton / In NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 1197-1219 refs

(I-6) CSCL 02F

Forest Service studies for integrating remotely sensed data into existing information systems highlight a need to: (1) re-examine present methods of collecting and organizing data, (2) develop an integrated information system for rapidly processing and interpreting data, (3) apply existing technological tools in new ways, and (4) provide accurate and timely information for making right management decisions. The Forest Service developed an integrated information system using remote sensors, microdensitometers, computer hardware and software, and interactive accessories. Their efforts substantially reduce the time it takes for collecting and processing data. Author

**N76-17531\*** Pilot Rock, Inc., Calif.

### **SPACE TECHNOLOGY PUTTING IT IN THE EDUCATIONAL PERSPECTIVE**

Donna B. Hankins / In NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 1221-1223

(I-7) CSCL 05B

One of the precepts of the company was to provide educators with practical, innovative, and manageable audio-visual teaching aids in a wide spectrum of educational fields, but primarily geography, geology and social science. A pilot slide set was prepared, demonstrating primary areas along the entire length of the San Andreas Fault Zone in California and Mexico. This set utilized several NASA infrared research aircraft photos, to more clearly delineate fault traces. A decision was made to mount a massive program of repackaging NASA generated infrared aircraft imagery into topical teaching sets. Author

**N76-17538\*** Earth Satellite Corp., Kinshasa (Zaire).  
**LANDSAT ACTIVITIES IN THE REPUBLIC OF ZAIRE**

Sendwe Ilunga / In NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 1313-1315

(I-14) CSCL 05B

An overview of the LANDSAT data utilization program of the Republic of Zaire is presented. The program emphasizes topics of economic significance to the national development program of Zaire: (1) agricultural land use capability analysis, including evaluation of the effects of large-scale burnings; (2) mineral resources evaluation; and (3) production of mapping materials for poorly covered regions. Author

**N76-17545\*** Department of Agriculture, Washington, D.C. Western Aerial Photography Lab.

### **USER SERVICES AVAILABLE FROM USDA'S AERIAL PHOTOGRAPHY FIELD OFFICE**

Ronald A. Dickson / In NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 1397-1402

(I-21) CSCL 05B

APFO furnishes LANDSAT imagery and supporting NASA aircraft imagery to NASA-funded principal investigators who are working within the agriculture discipline. The office holds and reproduces Skylab imagery and a variety of aircraft photography (including infrared) from various government agencies. Available products are listed. Other topics discussed include quality control of photographic materials, analytical aerotriangulation, and photographic processes. Author

**N76-17546\*** Office of Information Services, Austin, Tex.

### **THE TEXAS REMOTE SENSING TRAINING PROJECT**

John B. Wells / In NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 1403-1414

(I-22) CSCL 05I

The project was designed to train federal, state and regional agency managers, scientists and engineers. A one-week seminar was designed and implemented to build vocabulary, introduce technical subject areas and give students enough training to allow them to relate remote sensing technology to operational agency projects. The seminar was designed to perform the dual function of conveying enough remote sensing information to be of value as a stand-alone and preparing students for detailed pattern recognition training. The LARSYS III portion of the training project was executed exactly as designed in the LARSYS training materials package; the LARSYS package did not contain a LANDSAT training module. Two LANDSAT training modules were developed using Texas LANDSAT data. One module contained central Texas data and the second module contained coastal zone data. Author

**N76-17549\*** General Electric Co., Philadelphia, Pa. Space Div.

### **THE TOTAL EARTH RESOURCES SYSTEM OF THE 1980'S: A VIEW OF THE FUTURE**

Charles E. Cheeseman and David W. Keller / In NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 1451-1472

(I-25) CSCL 12B

The study was organized to address the total earth resources system in the broadest sense: distinguishing characteristics of the resources form the input, and information from user models forms the output. The effort began with a treatment of resource management requirements which traced information needs back to budgets, laws, and charters. These requirements were used to structure a 1980's scenario and to define thirty broad resource management missions (or applications) which could be confidently expected to be carried out by the future system. A classical systems approach was followed to assess the current state-of-the-art, structure system requirements, and to define the necessary platforms, sensors, and ground system architecture. The study of two resource management missions in additional detail was conducted to illuminate problems of transition from R&D to

operational systems. The space shuttle's role in the system received special attention and a mission able to be served by an early flight was defined. Author

**N76-17550\*** General Electric Co., Philadelphia, Pa. Space Div.

**EARTH RESOURCES SURVEY AND THE SPACE SHUTTLE**  
W. Kent Stow and Roman W. Andryczyk *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-B Jun. 1975 p 1473-1482 refs

(I-26) CSCL 22A

The impact that the shuttle is expected to have on the Earth Resources Program and several concepts for exploiting the shuttle characteristics are discussed. The utilization of the space shuttle in its sortie mode for earth resources and the application of an earth observations standard package to earth resources missions were studied. Author

**N76-17560\*** Wisconsin Univ., Madison: Inst. for Environmental Studies.

**CASES IN THE RELATION OF RESEARCH ON REMOTE SENSING TO DECISIONMAKERS IN A STATE AGENCY**  
James W. Jondrow *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975 p 1617-1630 refs

(L-8) CSCL 05A

The use is considered of various management tools in order to assess their effects on the anticipated relevance of the remote sensing research to the needs of government agencies. Among these tools are different organizational structures and ways of functioning, which are applied to the design and management of projects and to the communication of research results. The characteristics of data and information flow, and technology transfer are discussed along with the management of three projects and a remote sensing data center in terms of the use of some tools for influencing these processes. Author

**N76-17566\*** Michigan State Univ., East Lansing.  
**IMPROVED RESOURCE USE DECISIONS AND ACTIONS THROUGH REMOTE SENSING**

R. Hill-Rowley, M. Boylan, W. Enslin, and R. D. Vlasin *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975 p 1747-1767

(L-16) CSCL 05A

Operational uses of remote sensing for improving management decisions and actions concerning resource uses are considered in terms of first generation, or direct-action; and second generation or indirect, delayed-action applications. From among applications completed during 1974-75, seven case studies are offered in illustration of the many contrasts which can be drawn between first and second generation application studies. These include: (1) multi-agency river basin planning; (2) corridor, assessment and route location for highway location together with improvement of county-level planning decisions; (3) improving timber management practices; (4) enforcement of new state statutes; (5) county-wide open space preservation; (6) land value reappraisal relative to property tax equalization; and (7) optimizing agribusiness processing plant locations. Author

**N76-17567\*** Washington Univ., Seattle.  
**DEVELOPMENT OF USER APPLICATIONS FOR EARTH RESOURCES SURVEY DATA IN URBAN AND REGIONAL PLANNING IN THE PUGET SOUND AREA**

Frank V. Westerlund *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 1-C Jun. 1975 p 1769-1784 refs

(DI-14-08-001-12864)

(L-17) CSCL 05A

User applications of remote sensing in Washington State are described. The first project created a multi-temporal land use/land cover data base for the environs of the Seattle-Tacoma International Airport, to serve planning and management

operations of the Port of Seattle. The second is an on-going effort to develop a capability within the Puget Sound Governmental Conference, a council of governments (COG), to inventory and monitor land use within its four county jurisdiction. Developmental work has focused on refinement of land use/cover classification systems applicable at this regional scale and various levels of detail in relation to program requirements of the agency. Related research, refinement of manual methods, user training and approaches to technology transfer are discussed. Author

**N76-17613\*#** National Aeronautics and Space Administration: Lyndon B. Johnson Space Center, Houston, Tex.

**NASA EARTH RESOURCES SURVEY SYMPOSIUM. VOLUME 3: SUMMARY REPORTS First Comprehensive Symposium on the Practical Application of Earth Resources Survey Data**

Jun. 1975 51 p refs Symp. held at Houston, Tex., 9-12 Jun. 1975 See also Vol. 1-A N76-17469; Vol. 1-B N76-17501; Vol. 1-C N76-17552; Vol. 1-D N76-17588 Original contains imagery. Original NASA photography may be purchased from the EROS DATA Center, 10th and Dakota Avenue, Sioux Falls, S.D. 5179 (NASA-TM-X-58168-Vol-3; JSC-09930-Vol-3) Avail: NTIS HC \$1.00 CSCL 05B

This document contains the proceedings and summaries of the earth resources survey symposium, sponsored by the NASA Headquarters Office of Applications and held in Houston, Texas, June 9 to 12, 1975. Topics include the use of remote sensing techniques in agriculture, in geology, for environmental monitoring, for land use planning, and for management of water resources and coastal zones. Details are provided about services available to various users. Significant applications, conclusions, and future needs are also discussed.

**N76-17618\*** Purdue Univ., Lafayette, Ind.  
**INFORMATION SYSTEMS AND SERVICES, USER SERVICES**

David A. Landgrebe *In* NASA. Lyndon B. Johnson Space Center NASA Earth Resources Surv. Symp., Vol. 3 Jun. 1975 p 29-33 (For availability see N76-17613 08-43) CSCL 05B

The following topics were discussed: (1) data availability and distribution, (2) complete processing systems, (3) subsystems, (4) applications, (5) research for future technology, and (6) education, training opportunities, and materials. Evidence was given that remote sensing technology is being increasingly utilized. Therefore, it was concluded that a second stage of remote sensing technology should be developed. D.M.L.

**N76-18195\*#** National Academy of Sciences - National Research Council, Washington, D.C.

**INSTITUTIONAL ARRANGEMENTS Practical Applications of Space Systems**

1975 56 p refs (Contract NSR-09-012-106) (NASA-CR-146275; Paper-10) Avail: NTIS HC \$4.50; Space Applications Board, National Research Council, 2101 Constitution Avenue, N.W., Washington, D.C. 20418 CSCL 14B

The practical application of space systems is considered in terms of institutional arrangements. The evolution of space systems is examined along with examples of institutional arrangements for space systems uses or applications. An institutional framework developed to assure the widest practicable application of space system is proposed and described. Recommendations are included. J.M.S.

**N76-18604\*#** Zurich Univ. (Switzerland).

**FOUR CONTRIBUTIONS TO THE SWISS ERTS AND EREP SATELLITE PROJECT**

Harold Haefner, Principal Investigator, Bruno Messerli, Matthias Winiger, Rudolf Gfeller, Klaus Seidel, and Urs Geiser 1975 19 p refs Repr. from *Geographica Helvetica* (Switzerland),



## 09 GENERAL

no. 3, 1975 p 97-114 In GERMAN Sponsored by NASA  
Original contains imagery. Original photography may be purchased  
from the EROS Data Center, 10th and Dakota Avenue, Sioux  
Falls, S. D. 57198 ERTS  
(E76-10183; NASA-CR-146279) Avail: NTIS HC \$3.50 CSCL  
05B

**N76-18973\*** Forecasting International Ltd., Arlington, Va.  
**LACK OF AGREEMENT OVER THE USE AND OWNERSHIP  
OF THE INTERNATIONALLY SHARED RESOURCES (SUCH  
AS AIR SPACE, OUTER SPACE AND THE OCEANS)  
LEADING TO INTERNATIONAL CONFLICT**

*In its The Future Environment* 15 Jul. 1975 29 p refs  
CSCL 05K

The lack of adequate institutional mechanisms to regulate,  
monitor and govern the use of commonly owned world resources  
appears to be politically destabilizing and subject to socioeconomic  
pressures of overpopulation, food shortages, cartelism, terrorism,  
and wealth distribution to developing countries. The capacity  
and propensity to wage war and its potential consequences are  
elaborated. It is shown that technology is one of the dominant  
factors affecting the exploration and management of commonly  
shared resources. G.G.

**N76-19533\*#** General Electric Co., Philadelphia, Pa. Space  
Div.

**LANDSAT-1 FLIGHT EVALUATION REPORT Quarterly  
Report, 23 Oct. 1974 - 23 Jan. 1975**

30 Apr. 1975 115 p  
(Contract NAS5-21808)  
(NASA-CR-143812; A-5086; QR-10) Avail: NTIS HC \$5.50  
CSCL 05A

Flight performance analysis for the tenth quarter of opera-  
tion orbit 11467 to 12745 of LANDSAT 1 are presented. Payload  
subsystems discussed include: power subsystem; attitude control  
subsystem; telemetry subsystem; electrical interface subsystem;  
narrowband tape recorders; wideband telemetry subsystem; return  
beam vidicon subsystem; multispectral scanner subsystem; and  
data collection system. J.M.S.

**N76-20024#** Committee of the Whole House on the State of  
the Union (U. S. House).

**TO AUTHORIZE APPROPRIATIONS TO THE NATIONAL  
AERONAUTICS AND SPACE ADMINISTRATION FOR  
RESEARCH AND DEVELOPMENT, CONSTRUCTION OF  
FACILITIES, AND RESEARCH AND PROGRAM MANAGE-  
MENT AND FOR OTHER PURPOSES**

Washington, GPO 1976 14 p H.R. 12453 referred to the  
Comm. of the Whole House on the State of the Union, 94th  
Congr., 2d Sess., 15 Mar. 1976

(H-Rept-94-897) Avail: US Capitol, House Document Room

The text of H.R. 12453, the National Aeronautics and Space  
Administration Authorization Act, 1977, is presented. The bill  
authorizes appropriations to NASA for research and development,  
construction of facilities, research and program management, and  
other purposes. D.M.L.

**N76-20587\*#** Army Construction Engineering Research Lab.,  
Champaign, Ill.

**EFFECTS OF CONSTRUCTION AND STAGED FILLING OF  
RESERVOIR ON THE ENVIRONMENT AND ECOLOGY  
Progress Report, 1 Jan. - 31 Mar. 1976**

Ravinder K. Jain, Principal Investigator 29 Mar. 1976 3 p  
ERTS  
(E76-10239; NASA-CR-146522) Avail: NTIS HC \$3.50 CSCL  
08H

**N76-21029#** Committee on Aeronautical and Space Sciences  
(U. S. Senate).

**NASA AUTHORIZATION FOR FISCAL YEAR 1977**

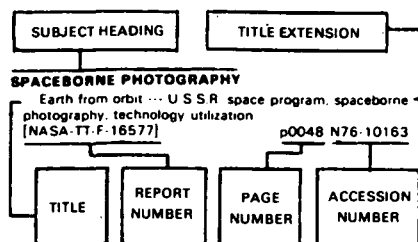
Moss, Washington GPO 30 Mar. 1976 57 p Rept. on H.R.  
12453 of Comm. on Aeron. and Space Sci., 94th Congr., 2d Sess.,

30 Mar. 1976

(S-Rept-94-718; GPO-57-010) Avail: U.S. Capitol, Senate  
Document Room

The bill to authorize appropriations to the National Aeronau-  
tics and Space Administration for research and development,  
construction of facilities, and research and program management  
is reported. Appropriations for FY 1977 are summarized in the  
following areas: space shuttle; space flight operations; expendable  
launch vehicles; physics and astronomy; lunar and planetary  
exploration; life sciences; space applications; earth resources  
operational systems; aeronautical research and technology;  
tracking and data acquisition; and technology utilization. J.M.S.

## Typical Subject Index Listing



The subject heading is a key to the subject content of the document. The title is used to provide a description of the subject matter. When the title is insufficiently descriptive of the document content, the title extension is added, separated from the title by three hyphens. The (NASA or AIAA) accession number and the page number are included in each entry to assist the user in locating the abstract in the abstract section (of this supplement). If applicable, a report number is also included as an aid in identifying the document. Under any one subject heading, the accession numbers are arranged in sequence with the AIAA accession numbers appearing first.

## A

### ABNORMALITIES

An investigation of thermal anomalies in the Central American volcanic chain and evaluation of the utility of thermal anomaly monitoring in the prediction of volcanic eruptions --- Central America  
[E76-10132] p0109 N76-16554

### ABSORPTION SPECTRA

Optical measurement of atmospheric pollutants - Accomplishments and problems p0080 A76-25502  
Total atmospheric column and tropospheric abundance measurement of nitrogen dioxide by absorption spectroscopy p0083 A76-25912

### ACOUSTIC SOUNDING

Remote temperature profiling in the lower troposphere p0086 A76-27105

### ADIRONDACK MOUNTAINS (NY)

The use of LANDSAT data to study mesoscale cloud features --- Adirondacks in New York, and New England [E76-10255] p0103 N76-20602

### AERIAL PHOTOGRAPHY

International Society of Photogrammetry, Symposium, Stuttgart Universitat, Stuttgart, West Germany, September 2-6, 1974, Proceedings p0161 A76-19134  
Analysis of digital multispectral scanner /MSS/ data p0162 A76-19142

A retrospective on earth-resource surveys - Arguments about technology, analysis, politics, and bureaucracy p0163 A76-20996

Shutter/aperture settings for aerial photography p0163 A76-21000

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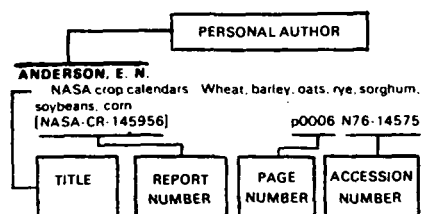
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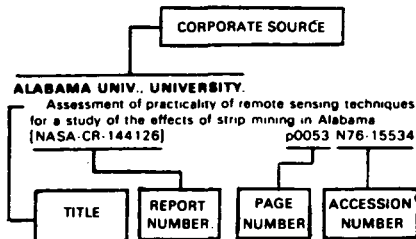
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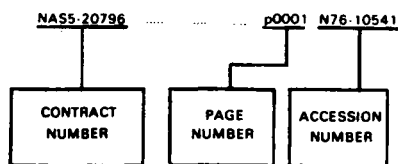
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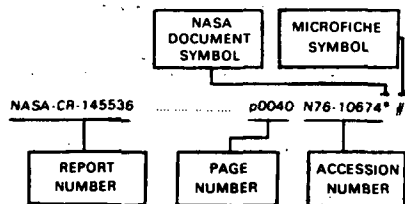


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PB-248079/6	p0107 N76-21777				

1. Report No. <b>NASA SP-7041 (10)</b>		2. Government Accession No.		3. Recipient's Catalog No.	
4. Title and Subtitle <b>EARTH RESOURCES A Continuing Bibliography (Issue 10)</b>				5. Report Date <b>August 1976</b>	
				6. Performing Organization Code	
7. Author(s)				8. Performing Organization Report No.	
9. Performing Organization Name and Address  <b>National Aeronautics and Space Administration Washington, D. C. 20546</b>				10. Work Unit No.	
				11. Contract or Grant No.	
12. Sponsoring Agency Name and Address				13. Type of Report and Period Covered	
				14. Sponsoring Agency Code	
15. Supplementary Notes					
16. Abstract  <p>This bibliography lists 807 reports, articles, and other documents introduced into the NASA scientific and technical information system between April 1976 and June 1976. Emphasis is placed on the use of remote sensing and geophysical instrumentation in spacecraft and aircraft to survey and inventory natural resources and urban areas. Subject matter is grouped according to agriculture and forestry, environmental changes and cultural resources, geodesy and cartography, geology and mineral resources, hydrology and water management, data processing and distribution systems, instrumentation and sensors, and economic analysis.</p>					
17. Key Words (Suggested by Author(s))  <b>Bibliographies Earth Resource Program Remote Sensors</b>			18. Distribution Statement  <b>Unclassified - Unlimited</b>		
19. Security Classif. (of this report) <b>Unclassified</b>		20. Security Classif. (of this page) <b>Unclassified</b>		22. Price* <b>\$4.00 HC</b>	
		21. No. of Pages <b>202</b>			

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